

INSTALLATION RESTORATION PROGRAM

AD-A277 739



FINAL

Site Investigation Report

(2)

Volume 2

Appendices A Through G

November 1992

161st AIR REFUELING GROUP
ARIZONA AIR NATIONAL GUARD
SKY HARBOR INTERNATIONAL AIRPORT
PHOENIX, ARIZONA



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THIS QUANTITY REFLECTED 3

Hazardous Waste Remedial Actions Program
Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

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1. Agency Use Only (Leave Blank)	2. Report Date NOV 1997	3. Report Type and Dates Covered SITE INVESTIGATION REPORT	
4. Title and Subtitle SLY HARBOR HAS EAST, PROPOSED, MS VOL. 2		5. Funding Numbers	
6. Author(s)			
7. Performing Organization Name(s) and Address(es) IT CORPORATION 312 DUNNICK DRIVE KNOXVILLE, TN 37422		8. Performing Organization Report Number	
9. Sponsoring/Monitoring Agency Name(s) and Address(es) Hazardous Waste Remedial Action Program Oak Ridge TN Air National Guard Readiness Center Andrews Air Force Base, Maryland 20331		10. Sponsoring/Monitoring Agency Report Number	
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13. Abstract (maximum 200 words) SITE INVESTIGATION OF HAS (S) HAS SITE AT SLY HARBOR, AIR NATIONAL GUARD BASE AND HAS (S) HAS AT PROPOSED REMEDIAL INVESTIGATION. THREE VOLUMES CONTAINING			
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FINAL
SITE INVESTIGATION REPORT
161ST AIR REFUELING GROUP
ARIZONA AIR NATIONAL GUARD
SKY HARBOR INTERNATIONAL AIRPORT
AND PAPAGO MILITARY RESERVATION
PHOENIX, ARIZONA

VOLUME 2
APPENDICES
A THROUGH G

Submitted To:

AIR NATIONAL GUARD READINESS CENTER
ANDREWS AIR FORCE BASE, MARYLAND

Submitted By:

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7606
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

Prepared By:

IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TENNESSEE 37923

NOVEMBER 1992

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List of Appendices

Appendix

Title

VOLUME 2

- A Variance and Nonconformance Reports
- B Preliminary Review of Hydrogeologic Data for Facilities Adjacent to Sky Harbor Air National Guard Base
- C Geophysical Survey Report
- D SOV Survey Report
- E Soil Boring Logs
- F Piezometer and Monitoring Well Completion Diagrams
- G Piezometer and Monitoring Well Development Records

VOLUME 3

- H Sample Collection Logs
- I Slug Tests and Analysis
- J Potentiometric Measurements
- K Results of Screening Analyses
- L Tabulation of Soil Analytical Results
- M Tabulation of Water Analytical Results

APPENDIX A

VARIANCE AND NONCONFORMANCE REPORTS



VARIANCE LOG

CHRONOLOGIC LIST OF PROJECT VARIANCES

PROJECT NUMBER 409721 PAGE 1 OF 1PROJECT NAME SKY HARBOR

DATE <small>VAR. # APPROVED BY</small>	VARIANCE GRANTED AND APPLICABLE DOCUMENT	RESPONSIBLE INDIVIDUAL
11/29/90	VAR. #1 USE OF DIFFERENT GC INSTRUMENT; FIELD SAMPLING PLAN (FSP)	S. SARES
11/29/90	VAR. #2 USE OF EVACUATED GLASS VIALS FOR SOV; FSP	S. SARES
12/11/90	VAR. #3 MODIFICATION OF SITE #3 SAMPLING POINTS	S. SARES / S. INMAN
12/12/90	VAR. #4 CHANGE IN ANALYTICAL PROCEDURES & EQUIPMENT FOR ON-SITE FIELD SCREENING OF SOIL BORINGS/SAMPLES	DOUG PERRY
1/11/91	VAR. #5 CHANGE IN PIEZO. / WELL SAND PACK	S. SARES
1/11/91	VAR. #6 CHANGE IN SOIL CLASSIFICATION AND SAMPLING FORMS	S. SARES
1/16/91	VAR. #7 SAMPLE COLLECTION / SHIPMENT	S. SARES
1/17/91	VAR. #8 CHANGE IN ANALYTE TESTS	OWEN L. FERGUSON
1/24/91	VAR. #9 SITE 4, DELETION OF ^{SOL} BORING SAMPLES	S. SARES
2/13/91	VAR. #10 GROUNDWATER SAMPLING PURGE PROCEDURES	S. SARES
4/9/91	VAR. #11 GROUNDWATER SAMPLING OF 2 IN. PIEZOMETER	S. SARES

VARIANCE FORM

VARIANCE NO. 1

PROJECT NO. 409721.02

PAGE 1 OF 1

PROJECT NAME SKY HARBOR AND BASE SI

DATE 29 Nov 90

VARIANCE (INCLUDE JUSTIFICATION)

THE SKY HARBOR WORK PLANS WERE PREPARED SPECIFYING A PHOTOVAC 10550 GC/PD FOR ANALYSIS OF SOV SAMPLES FOR AROMATIC AND HALOGENATED VOLATILE ORGANIC COMPOUNDS. DETECTION LIMITS FOR THIS EQUIPMENT ARE TYPICALLY 20-100 PPB (UG/L) FOR SOV AROMATIC SAMPLES AND 50 PPB FOR HALOGENATED. THE SUBCONTRACTOR SELECTED FOR SOV ANALYSIS PROPOSES TO UTILIZE A "SHIMADZU 14A" GAS CHROMATOGRAPH WITH FID AND ECD RATHER THAN THE PHOTOVAC. THE SHIMADZU EQUIPMENT IS "LABORATORY QUALITY" AS OPPOSED TO A "FIELD" SCREENING INSTRUMENT LIKE THE PHOTOVAC 10550. USE OF THE SHIMADZU SHOULD PROVIDE MORE EFFICIENT LABORATORY OPERATION AND LOWER DETECTION LIMITS. DETECTION LIMITS FOR THE SHIMADZU ^{SUB} ~~WHICH~~ ¹¹⁻²⁹⁻⁹⁰ ARE EXPECTED TO BE APPROXIMATELY 0.1 TO 1 PPB FOR HALOGENATED COMPOUNDS AND 1 PPB FOR AROMATIC COMPOUNDS.

APPLICABLE DOCUMENT:

SECTION 5.2
FINAL SITE INVESTIGATION FIELD SAMPLING PLAN, 161ST AIR REFUELING GROUP, AE, AIR NATIONAL GUARD, SKY HARBOR INTERNATIONAL AIRPORT, PHOENIX, ARIZONA, SEPTEMBER 1990.

CC: B. Stanley (MMFS)

REQUESTED BY [Signature]

DATE 11-29-90

APPROVED BY [Signature]

DATE 11/29/90

Project Manager

Quality Assurance Officer

DATE 30 NOV 90

DATE 1/21/91

INTERIM PROJECT MGR.

VARIANCE FORM

VARIANCE NO. 2

PROJECT NO. 409721.02

PAGE 1 OF 1

PROJECT NAME SKY HARBOR AND BASE SI

DATE 29 NOV 90

VARIANCE (INCLUDE JUSTIFICATION)

SOV SAMPLE CONTAINER CHANGE FROM TEDLAR BAG TO EVACUATED GLASS VIAL.
CONTAINER FILL METHOD CHANGE FROM DESSICATOR DEFLECTION TO ACTIVE PLACEMENT.

SKY HARBOR WORK PLANS WERE PREPARED USING IT'S NORMAL PROCEDURE FOR SAMPLE COLLECTION. RFPs WERE LET TO TWO QUALIFIED FIRMS FOR EXECUTION OF SOV SURVEY. EACH FIRM RESPONDED WITH MINOR CHANGES TO SAMPLE COLLECTION AND HANDLING PROCEDURES. THE VENDOR WITH PROCEDURES MOST CLOSELY FOLLOWING IT'S WAS SELECTED. THE METHOD OF COLLECTION IS DESCRIBED BELOW.

SAMPLE CONTAINERS ARE EVACUATED GLASS VIALS RATHER THAN TEDLAR BAGS. THE VIALS WILL BE FILLED BY ACTIVE SYSTEM RATHER THAN DESSICATOR DEFLECTION. VIALS MEET EPA CLEANING CRITERIA FOR ORGANIC COMPOUNDS. SAMPLES ARE PUMPED INTO VIALS AT 15 PSIG.

THE USE OF "EPA CLEAN" GLASS VIALS INSTEAD OF TEDLAR BAGS ^{SUB} ~~WILL NOT CHANGE~~ ¹¹⁻²⁷⁻⁹⁰ AND THE ACTIVE PLACEMENT METHOD WILL NOT ^{CHANGE} ~~CHANGE~~ DATA QUALITY; RATHER, PLACEMENT OF SAMPLES INTO CONTAINERS AT HIGHER THAN ATMOSPHERIC PRESSURE SHOULD DECREASE POTENTIAL FOR SAMPLE CONTAMINATION DUE TO CONTAINER LEAKS AS ANY LEAKS WOULD BE FROM THE CONTAINER TO THE ATMOSPHERE. THE PROPOSED SAMPLE COLLECTION METHOD WILL BE CONSISTANT WITH PQO LEVEL B.

APPLICABLE DOCUMENT:

FIELD SECTION 5.2
FINAL SITE INVESTIGATION, SAMPLING PLAN, 161ST AIR REFUELING GROUP, AZ, AIR NATIONAL GUARD,
SKY HARBOR INTERNATIONAL AIRPORT, PHOENIX, AZ, SEPTEMBER 1990.

CC: J. S. Stanley (MME)

REQUESTED BY Steve W. Ball

DATE 11-29-90

APPROVED BY [Signature]

DATE 11/29/90

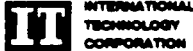
Project Manager

[Signature]
Quality Assurance Officer

DATE 30 NOV 90

[Signature]
HARVEST PROJECT MGR.

DATE 1/21/91



VARIANCE FORM

VARIANCE NO. 3

PROJECT NO. 409721 PAGE 1 OF 1

PROJECT NAME SKY HARBOR AND CASE SITE DATE 12/11/90

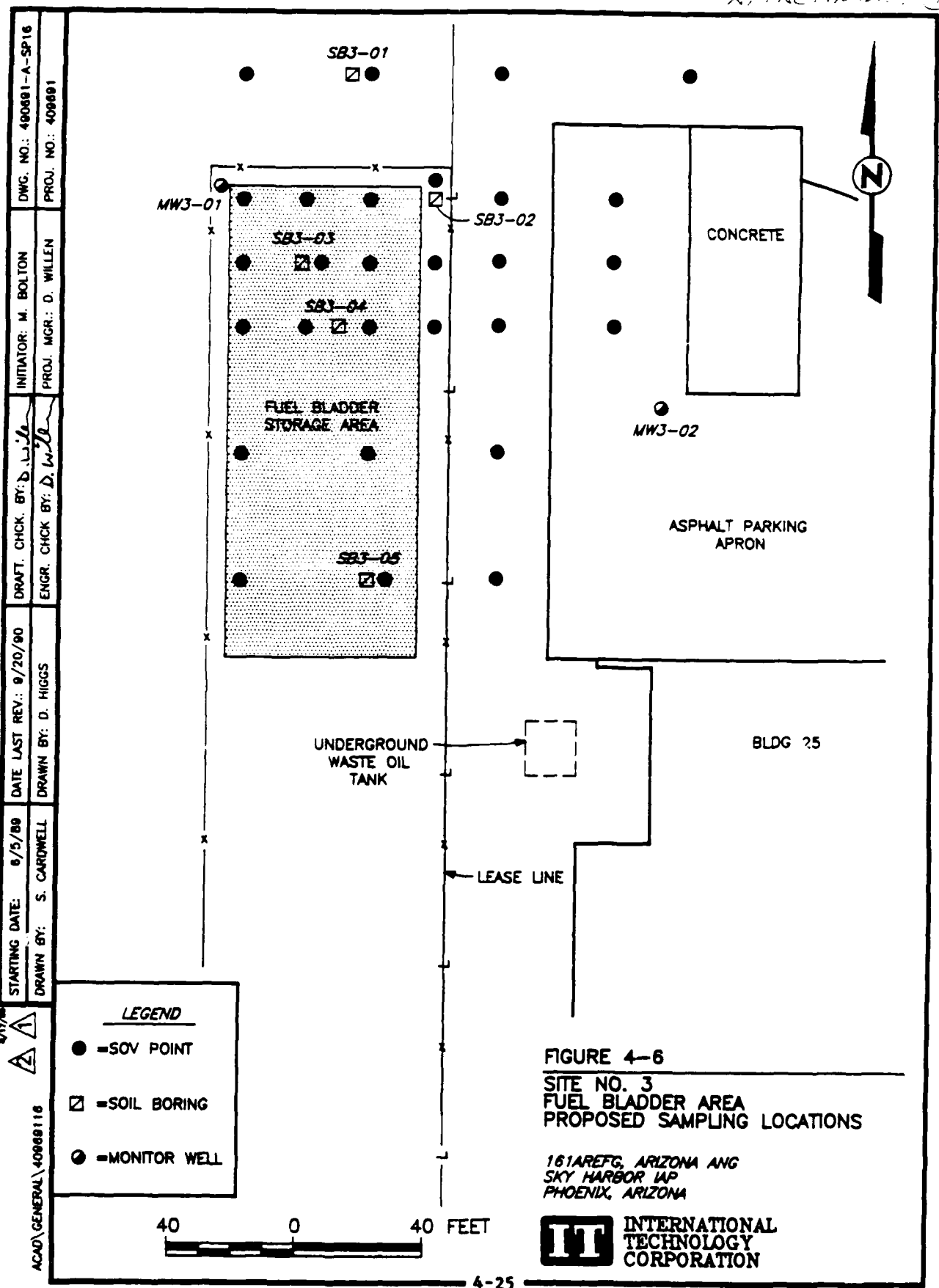
VARIANCE (INCLUDE JUSTIFICATION)

THE FIELD SAMPLING PLAN WAS PREPARED UTILIZING EXISTING BLUE LINE DRAWINGS FROM THE BASE. IN PARTICULAR, SITE 3 WAS A FUEL STORAGE AREA BELIEVED TO HAVE BEEN WITHIN A CYCLONE FENCED AREA (ATTACHMENT 1). RECENT UTILITY CLEARANCE ACTIVITIES DISCLOSED A 1972 MAP SHOWING THE FUEL STORAGE AREA ADJ. 150 FT. WEST OF LEASE LINE. THE PURPOSE OF THIS VARIANCE IS TO REQUEST MODIFICATION OF SAMPLING AREAS TO THOSE SHOWN ON ATTACHMENT 2. NO SCOPE CHANGE IS ENVISIONED. THE SAME SAMPLING POINTS OCCUR BUT IN SLIGHTLY DIFFERENT LOCATION TO ADEQUATELY CHARACTERIZE THE SITE.

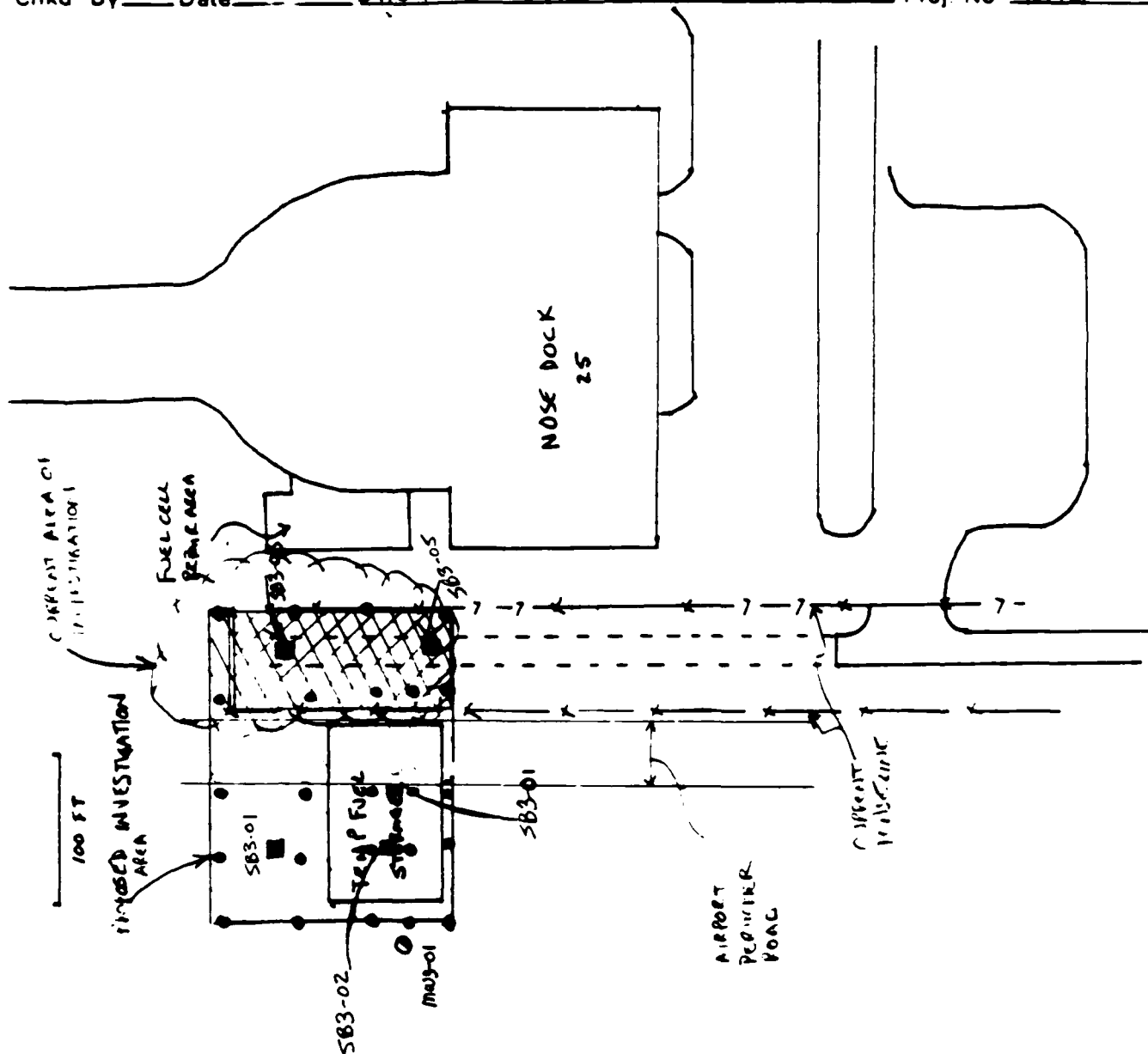
APPLICABLE DOCUMENT:

FINAL FIELD SAMPLING PLAN, ~~APP~~ SECTION 4.6, SITE 3, FUEL BLADDER STORAGE AREA; AB A.R. NATIONAL GUARD, SKY HARBOR INTERNATIONAL

CC: David Bunn <i>EB</i>	REQUESTED BY <i>D. W. L.</i>	DATE <u>12/11/90</u>
HAZWRAP Files -0449	APPROVED BY <i>D. W. L.</i>	DATE <u>12/11/90</u>
	Project Manager	
	<i>R. D. Meek</i>	DATE <u>11 DEC 90</u>
	Quality Assurance Officer	
	<i>1/10/91</i>	DATE <u>4/15/91</u>



By SWS Date 11 DEC 90 Subject SKETCH MAP OF AREA AROUND Sheet No 1 of
Chkd By Date SITE NO 3 ADAPTED FROM BASE ENG. DRAWING Proj. No 409321





INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE NO. 42

VARIANCE LOG

PROJECT NO. 409721 PAGE 1 OF 2
PROJECT NAME AIR NATIONAL GUARD SKY HARBOR DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

PURPOSE:

The purpose of this variance is to document a change in the analytical procedure and equipment for on-site field screening analysis of soil boring samples at Sky Harbor National Guard. This change does not affect the target compounds or the intended use of the resulting data, but allows a more accurate qualification and quantification of the target compounds.

CHANGE:

Originally as stated in the SAP, a Photovac 10S50 portable gas chromatograph (GC) using headspace technique was to be used to determine relative concentrations of the target compounds.

The change will be to replace the 10S50 GC with a SRI model 8610 GC equipped with an PID and FID detector in series, purge and trap, and Peaksimple data system. The onboard integrator of the 10S50 will be replaced with a laptop computer and printer.

APPLICABLE DOCUMENT:

FIELD SAMPLING PLAN, SECTION 5.2, SOV SURVEY / FIELD SCREENING

CC: B. Stanley (MMES)

REQUESTED BY: [Signature] DATE: 12/14/90

APPROVED BY: [Signature] DATE: 12/12/90

[Signature] DATE: 12 DEC 90
Project Manager

[Signature] DATE: 1/24/91
Quality Assurance Officer

[Signature] DATE: 1/24/91
HAZWOP Project Mgr.

409721-7



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE NO. 42

VARIANCE LOG

PROJECT NO. 409721 PAGE 2 OF 3
PROJECT NAME AIR NATIONAL GUARD SKY HARBOR DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

JUSTIFICATION:

1. The headspace procedure is an indirect method for determining the concentration of compounds. The use of the SRI with the purge and trap allows direct measurement of the compounds. Because of the direct measurement:
 - lower detection limits are obtainable
 - there will be less variability of measurement therefore the data will be more accurate
 - less sample prep equipment is required causing a reduction in cost, time, and potential biasing and errors
 - more accurate simulation of standard laboratory procedures
2. Because the SRI utilizes the FID and PID in series it is easier to more accurately identify and quantify the target compounds in a complex chromatograph by comparing the results of the two detectors. The 10S50 only utilizes the PID thus relying more on the operators interpretation.

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: [Signature] DATE: 12/12/90

APPROVED BY: _____ DATE: _____

Project Manager

Quality Assurance Officer

DATE: _____

DATE: _____

408819-7



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE NO. 42

VARIANCE LOG

PROJECT NO. 409721 PAGE 3 OF 3
PROJECT NAME AIR NATIONAL GUARD SKY HARBOR DATE: 12/11/90

VARIANCE (INCLUDE JUSTIFICATION)

JUSTIFICATION (continued):

3. The interfacing and utilization of a laptop computer by the SRI allows chromatographic data to be stored on floppy disk in a format that permits the data to be easily stored and recalled at any future time for reexamination, integration and manipulation. The 10S50 does not allow this without the addition of extra peripheral support.
4. The higher level of technology in the SRI allows the operator to easily and more accurately control the GC operational parameters thus allowing for more accurate qualification and quantification of the target compounds

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: Dave Key DATE: 12/11/90

APPROVED BY: _____ DATE: _____

Project Manager

Quality Assurance Officer

DATE: _____

DATE: _____

40810-7



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE FORM

VARIANCE NO. 5

PROJECT NO. 40972/02.06

PAGE 1 OF 3

PROJECT NAME SKY HARBOR ANG - SI

DATE 11 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN PIEZO/WELL SAND PACK.

Drillers requested substitution of silica sand specification for piezometers and monitoring well sand pack from 30-60-40 mesh (current work plan) to 20/40 mix. 30-40 mesh sand is not a readily available product and obtaining special mix will cause delay and added expense. 20/40 mesh is similar gradation and is commonly used with screen size to be used (0.010 in slot).

The 20/40 Sand is suitable for use with 0.010 slot screen and should not cause data quality to be effected. The 20/40 sand with the 0.010 screen size is recommended in HAZWRAP position paper #4, pg. 12.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, AZ Air National Guard, Sky Harbor International Airport, Phoenix Arizona, Sept. 1990, Section 5.5.3.1, Pg 5-20

CC: WILLIAM
DYBURSKI
D. MACK

B. Stanley (MMES)

REQUESTED BY [Signature]

DATE 11 JAN 91

APPROVED BY [Signature]

DATE 1/16/91

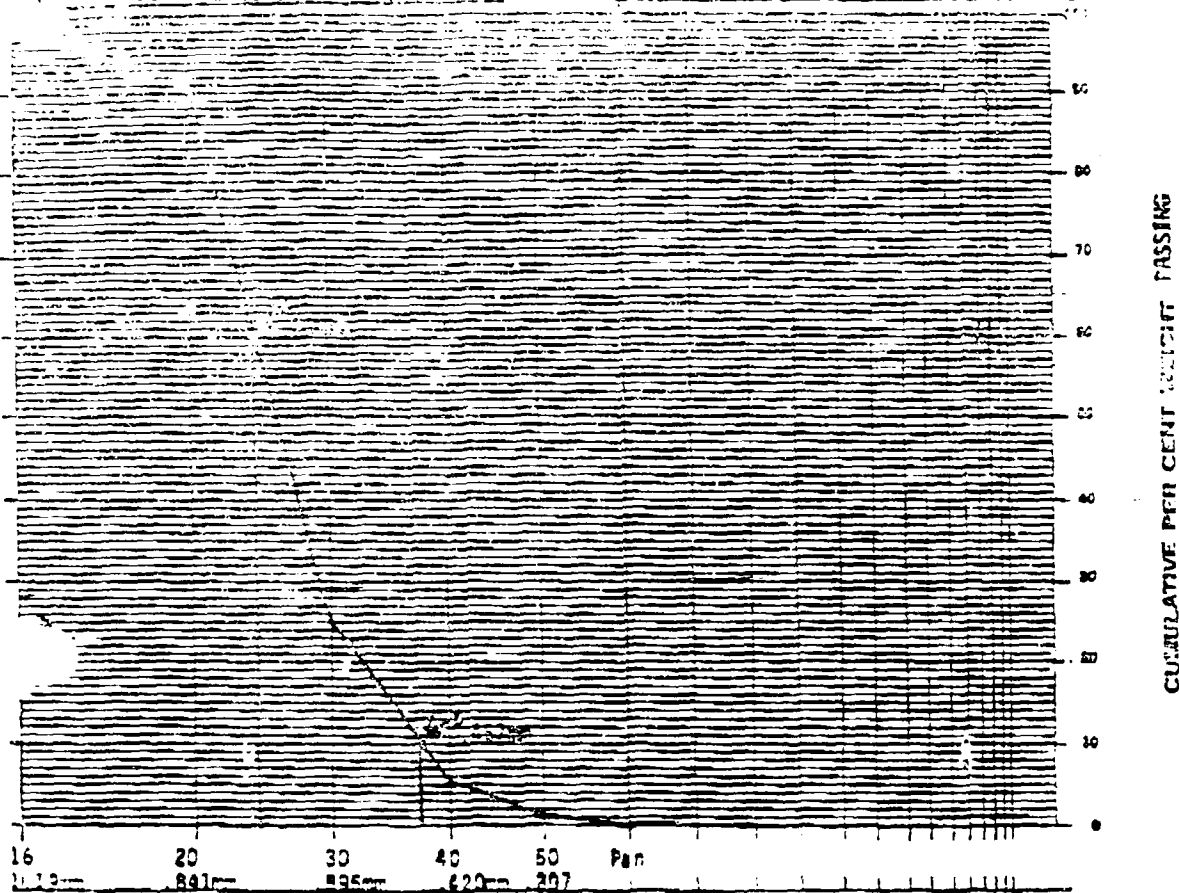
Project Manager

[Signature]
Quality Assurance Officer

DATE 11 JAN 91

DATE 1/18/91

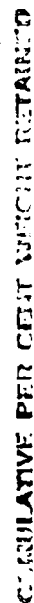
Form No. 1 of Two Series for Class Biding
 Cumulative Direct Diagram of Percent Retention on Sample of _____
 Effective Size .45mm .60 .75 Date _____



Screens		Tyler Mesh	U. S. No.	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights	Sample Weights	Per Cent	Per Cent Cumulative Weights
INCHES	MILLIMETERS											
			16			100						
			20			93.2						
			30			75.2						
			40			5.2						
			60			1.2						
			75			-						

Green Bay, Wis.

Date _____

[illegible]



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE FORM

VARIANCE NO. 6

PROJECT NO. 409721.02.06

PAGE 1 OF 7

PROJECT NAME SKY HARBOR ANG BASE SI

DATE 11 Jan 91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN SOIL CLASS. & SAMPLING FORMS

Substitute the following field description forms for forms described in work Plans. The "new" forms are specified in HAZWOP Guidance documents as preferred to maintain program consistency. The replacement forms contain the same or more information as the work plan forms.

Current WP Form Replacement

① Visual Classification of Soils
Fig 5-3

Boring Log - Rev Date May 1990 (Figure 5-3a)

② No Form

Monitoring Well Construction Log - Rev Date May 1990 -
Standard and Flush Mount Form 5-4a & 5-4b

③ No Form

Monitoring Well Development Log - Rev Date May 1990,
Including Post Development Water Level
Recovery Graph (Figures 5-4c & 5-4d)

④ Sampling Information Form
Fig 5-6

Monitoring Well Logging Log - Rev Date May 1990 (Fig 5-5a)
Monitoring Well Sampling Log - Rev Date May 1990 (Fig 5-6a)

THE FSP IS MODIFIED AS FOLLOWS: PG. 5-17, SECT. 5.5.2, 2ND SENTENCE, IS MODIFIED TO READ, "THE INFORMATION RECORDED ON THE BORING LOG FORM (FIGURE 5-3a) WILL ALSO INCLUDE ---"; PG. 5-24, SECT. 5.5.3.2, LAST SENTENCE, REPLACE REFERENCE TO "FIGURE 5-4" WITH "FIGURES 5-4a AND 5-4b"; PG. 5-25, SECT. 5.5.4, LAST PARA, 2ND SENTENCE, IS MODIFIED AS FOLLOWS: "FIELD TURBIDITY AND OTHER DEVELOPMENT RESULTS WILL BE REPORTED ON FIGURES 5-4c AND 5-4d FOR EACH WELL." PG. 5-30, SECT. 5.7.4.2, LAST SENTENCE, IS MODIFIED BY REPLACING, "FIGURES 5-4" WITH "FIGURES 5-6a AND 5-6b."

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, AZ Air National Guard, Sky Harbor International Airport, Phoenix, AZ, Sept 1990, Section 5.5.3.2, 5.7.4.2, 5.5.2

CC: WILLIEN
TYBURESKI
D. MACK
B. Stanley (MMES)

REQUESTED BY [Signature]

DATE 11 Jan 91

APPROVED BY [Signature]

DATE 1/11/91

Project Manager

Quality Assurance Officer

DATE 4 JAN 91

DATE 1/18/91

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

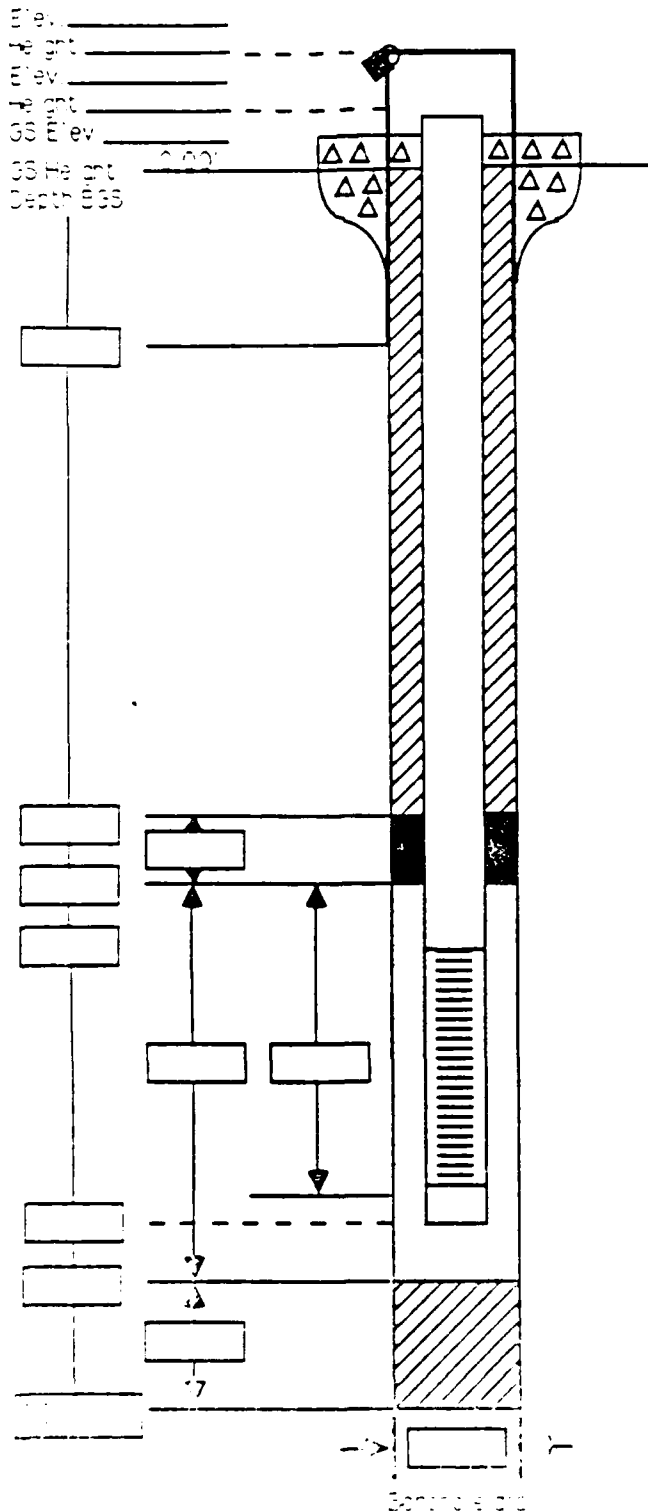
EPA REG LOG		BORING WELL NO.		Page _____ of _____	
Installation Sky Harbor		Coordinates:		Site	
Project No.		Client/Project:			
HACWRAP Contractor		Drill Contractor		Driller	
Drill Started _____ mi		Drill Ended _____ mi		Screened and/or	
Drill Method/Drill Type					
Logged by		E-Log (Y / N) From _____ to _____		Protection Level	

[illegible]

FIGURE 5-4a

REV. DATE MAY 1997

MONITORING WELL CONSTRUCTION LOG -- Standard			
Well No.	Installation Sky Harbor	Coordinates:	Site
Project No.	Client/Project:		
HAZWRAP Contractor:		Drill Contractor:	
Comp. Start	() m	Comp. End	m
Built By	Well Coord.		



PROTECTIVE CSG
 Material / Type _____
 Diameter _____
 Depth BGS _____ Weep Hole (Y / N) _____

GUARD POSTS (Y / N) _____
 No. _____ Type _____

SURFACE PAD
 Composition & Size _____

RISER PIPE
 Type _____
 Diameter _____
 Total Length (TOC to TOS) _____
 Ventilated Cap (Y / N) _____

GROUT
 Composition & Proportions _____
 Tremied (Y / N) _____
 Interval BGS _____

CENTRALIZERS (Y / N) _____
 Depth(s) _____

SEAL
 Type _____
 Source _____
 Setup/Hydratation time _____ Vol. Fluid Added _____
 Tremied (Y / N) _____

FILTER PACK
 Type _____
 Amt. Used _____
 Tremied (Y / N) _____
 Source _____
 Gr. Size Dist. _____

SCREEN
 Type _____
 Diameter _____
 Slot Size & Type _____
 Interval BGS _____

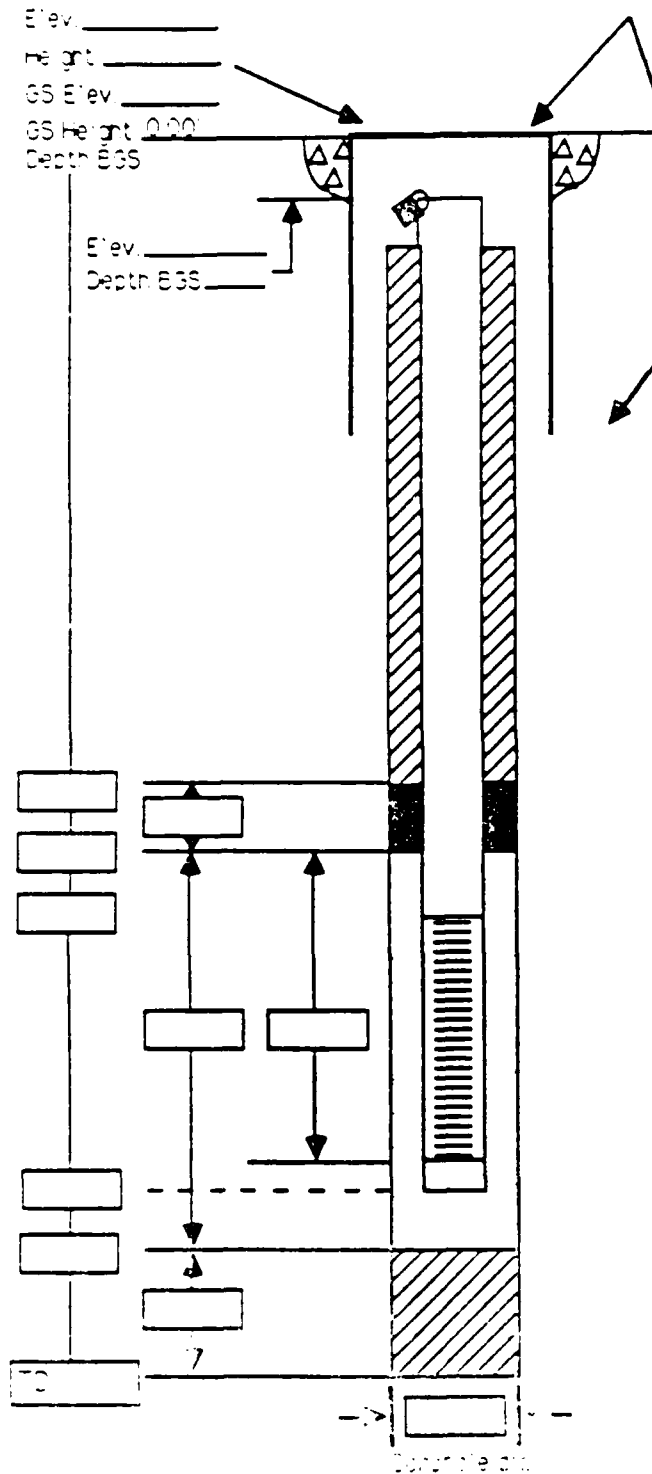
SUMP (Y / N) _____
 Interval BGS _____ Length _____
 Bottom Cap (Y / N) _____

BACKFILL PLUG
 Material _____
 Setup/Hydratation time _____
 Tremied (Y / N) _____

FIGURE 5-4b

REV DATE MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount			
WELL NO:	Installation: Sky Harbor	Coordinates:	Site:
Project No:	Client/Project:		
HADWRAP Contractor:	Drill Contractor:		
Comp. Start:	() m	Comp. End:	() m
Built By:	Well Coord:		



PROTECTIVE CSG

Material / Type _____
Diameter _____
Depth BGS _____
Watertight O-Ring (Y / N) _____

SURFACE PAD

Composition & Size _____
Breathes With Vadose Zone (Y / N) _____

RISER PIPE

Type _____
Diameter _____
Total Length (TOC to TOS) _____
Ventilated Cap (Y / N) _____

GROUT

Composition & Proportions _____

Tremied (Y / N) _____
Interval BGS _____

CENTRALIZERS (Y / N)

Depth(s) _____

SEAL

Type _____
Source _____
Setup/Hydration time _____ Vol. Fluid Added _____
Tremied (Y / N) _____

FILTER PACK

Type _____
Amt. Used _____
Tremied (Y / N) _____
Source _____
Gr. Size Dist. _____

SCREEN

Type _____
Diameter _____
Slot Size & Type _____
Interval BGS _____

SUMP (Y / N)

Interval BGS _____ Length _____
Bottom Cap (Y / N) _____

BACKFILL PLUG

Material _____
Setup/Hydration time _____
Tremied (Y / N) _____

40. 40.

0000

Disposition of discharge water _____[illegible]

POST DEVELOPMENT WATER LEVEL RECOVERY GRAPH

REV DATE MAY 1990

Well Recording Instrument

Start Recovery () End Recovery () Total Recovery Time

Beginning WL Final SWL Project Name No.

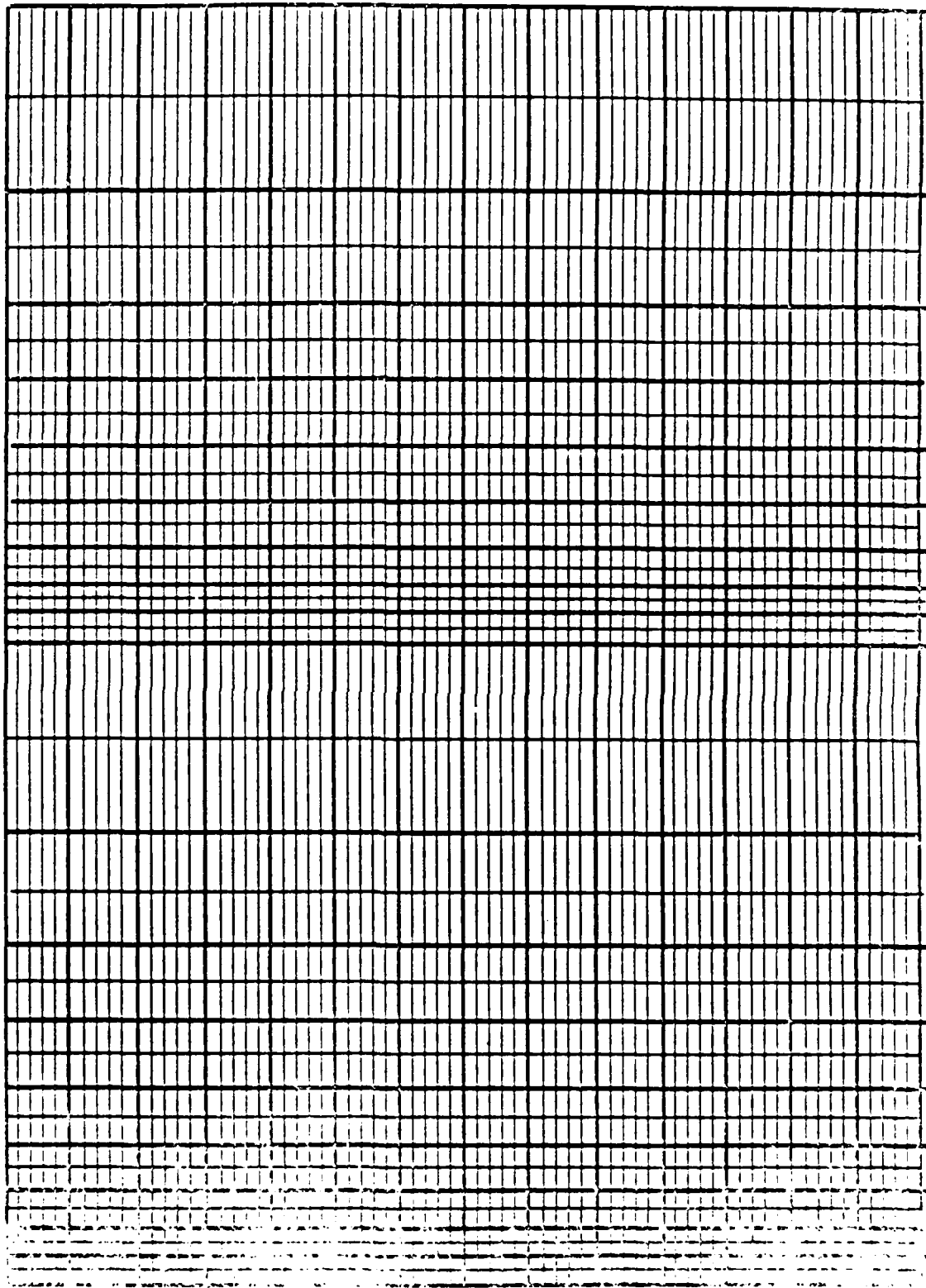


FIGURE 5-42

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[illegible]

FIGURE 5-6 b

MONITORING WELL SAMPLING LOG		Sample D No.
Installation: Sky Harbor Coordinates		Well No.
HAZWRAP Contractor:		Project No.
Sample Start (Date)	(Time)	Sample End (Date)
Sampled by:		

Orig. SWL _____ ft BTCC* Final SWL _____ ft BTCC

Screen Interval: _____ - _____ ft BTCC

Temp	pH	Cond	Turbidity

Are parameters 20%
of purge values? Y / N

Repurge Y / N

No. repurge volumes _____

Sampling Method

 Submersible Pump ☐ Dedicated Bladder Pump ☐ Bladder Pump ☐ Bailor ☐ SS ☐
 Tef ☐ Centrifugal Pump ☐
 PVC ☐
Peristaltic Pump ☐ Hand Pump ☐ Gas Lift/ Displacement Pump ☐ Other _____

Sampling Equipment (Make, Model, etc.) _____

Sample Equipment Decont'd? Y / N

If pump or discrete bailer, Depth(s) where pump set: _____ ft BTCC

Weather _____ (°F)

Lab Analyses (Circle)

VOA SVOA METALS PEST/PCBS TPH CATIONS ANIONS TDS

Others _____

Metals (Circle) Filtered Unfiltered Both

Field Dups. Y / N Reference Dups. Y / N

Comments

 BTCC = Below Top of Casing (or other measurement reference point)
 SWL = Static Water Level

Figure 6-1

Section No.: 6.0
Revision No.: 1
Date: 2/09/90
Page 4 of 6



VARIANCE FORM

VARIANCE NO. 7

PROJECT NO. 409721 PAGE 1 OF

PROJECT NAME SKY HARBOR ANG BASE SI DATE 16 Jan 91

VARIANCE (INCLUDE JUSTIFICATION) SAMPLE COLLECTION/SHIPMENT

Section 6.2 of the Field Sampling Plan specifies that samples will be packaged and shipped... within 24 hours of collection, and coolers containing samples will be shipped by next-day delivery service. Field work for the SI is on a 4 day off-10 day on schedule for cost efficiency. ~~So~~ Because of the schedule ~~the~~ samples will be collected on Saturday and Sunday, periodically. ~~Given~~ ^{Since} samples collected on Sunday cannot be shipped overnight because delivery services typically do not work on Sunday. This variance allows for samples collected on Sunday to be shipped on Monday for Tuesday delivery at the laboratory. Samples collected on Saturday could be shipped for Monday delivery; however this would require them to sit in a warehouse on Sunday. This variance allows for soil samples collected on Saturday to be shipped ~~for~~ ^{on} Monday for Tuesday delivery. Using this schedule a sample collected Saturday would be 3 days old upon arrival at the laboratory. The shortest soil-holding time for analysis to be tested is 14 days. This variance allows the lab 11 days to meet holding time.

Water samples will not be collected on weekends, with the exception of rinsate blanks. Rinsate blanks which must be collected on weekends will be specially scheduled with the laboratory to meet holding times.

APPLICABLE DOCUMENT:

Final Field Sampling Plan, 161st Air Refueling Group, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, AZ. SECTION 6.2 (PS 6-1)

CC: D. MACK

J. TYBURSKI

P. Bunn (HAZWAP)

HAZWAP Files-0449

REQUESTED BY [Signature]

DATE 1-6-91

APPROVED BY [Signature]

DATE 1/16/91

Project Manager

Quality Assurance Officer

DATE 1/22/91

DATE 4/16/91

Figure 6-1

Section No.: 6.0
Revision No.: 1
Date: 2/09/90
Page 4 of 6



VARIANCE FORM

VARIANCE NO. 8

PROJECT NO. 409721 PAGE 1 OF 1

PROJECT NAME Sky Harbor AUG DATE 1/16/91

VARIANCE (INCLUDE JUSTIFICATION) CHANGE IN ANALYTE TESTS

The current CLP Statement of Work covers the Target Compound List (TCL) which replaces the Hazardous Substance List (HSL) as in older Statements of Work. Four (4) organic compounds which were on the HSL are not on the TCL

(Volatiles: 2-chloroethyl vinyl ether ;
Semivolatiles: N-nitrosodimethylamine, aniline, benzidine)

ITAS/Cerritos requests a variance to the Sky Harbor GAPP to omit these compounds from the analytical testing program (Table 9-3: Analyte # 26, # 36, # 38, # 39C)

APPLICABLE DOCUMENT: field Sampling Plan - Appendix A
(GAPP) TABLE 9-3

CC: C. FERGUSON

~~S. GARRIS~~

J. DYBURSKI

D. MACK

D. BURN HAZWRAP

HAZWRAP Files -0449

REQUESTED BY Cheryl Ingham/ITAS

APPROVED BY [Signature]

Project Manager

Quality Assurance Officer

DATE 1/16/91

DATE 4/17/91

DATE 17 JAN 91

DATE 4/8/91



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE FORM

VARIANCE NO. 9

PROJECT NO. 402721 PAGE 1 OF 1

PROJECT NAME SKY HARBOR ANG BASE SI DATE 22 JAN 91

VARIANCE (INCLUDE JUSTIFICATION) SITE 4, DELETION OF ~~SOIL~~ BORING SAMPLES

The Field Sampling Plan (FSP) Section 4.7.2 specifies that a minimum of 2 soil borings are to be completed at Site 4. Section 4.7.6 specifies that the borings will be 20-45 feet deep, depending on the depth to water. Soil samples are to be collected at 5-foot-depth intervals and three from each boring are to be submitted for laboratory analysis.

During the initial hydrogeologic characterization, the hammer rig penetration rate was approximately 1 ft per hour. The soil materials are ~~fine~~ sand, gravel, weathered breccia to approximately 10' below this is caliche and volcanic bedrock. The conditions will not allow collection of split spoon samples due to penetration difficulties.

In lieu of installing soil borings this variance will allow collection of surficial soil samples to assess soil contamination from site 4. Six samples will be collected, 3 at the current drum storage area, 2 at the PA-drum storage area, and one background sample located east of PB-01. Samples will be collected from the ground surface, below any gravel cover, using a slide hammer with brass sample rings. If no sample recovery is obtained after three attempts, samples may be collected with a stainless-steel trowel and placed in a 250 ml glass jar and 2-40 ml vial.

Samples are also to be collected from monitoring well boreholes, as specified in section 4.7.7. Due to adverse subsurface conditions ~~soils~~ (e.g. bedrock) soil samples will not be able to be installed ~~and~~ collected from monitoring wells at Papego.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan, 161st Air Refueling Group, Sky Harbor Air National Guard, Sky Harbor International Airport, Phoenix Arizona, Sept. 1990. Sections 4.7.2, 4.7.6, 4.7.7.

CC: David Bunn
HAZWOP Files -0449

REQUESTED BY [Signature]

DATE 24 Jan 91

APPROVED BY [Signature]

DATE 1/24/91

Project Manager

Quality Assurance Officer

DATE 24 JAN 91

DATE 4/15/91

IR-67326-0449 55
Sky Harbor

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FEB 10 3 00 PM '91 Figure 8-1

Section No.: 8.0
Revision No.: 1
Date: 2/09/90
Page 4 of 8



VARIANCE FORM

VARIANCE NO. 10

PROJECT NO. 469721

PAGE 1 OF 2

PROJECT NAME SKY HARBOR ANGB SI

DATE 13 Feb 91

VARIANCE (INCLUDE JUSTIFICATION)

GROUNDWATER SAMPLING PURGE PROCEDURE (FSP Sec 5, 3.4.1)

The calculated purge volume for monitoring wells at the Sky Harbor site is approximately 145 gallons (3 well volumes) assuming 90% porosity in the casing - borehole annulus.

The sampling plan specifies the wells will be purged using bailers or bladder pumps.

Using a 3 inch diameter - 3 foot long bailer will require ~130 trips to purge a well, using a bladder pump against 100' head requires a 2-stage pump to achieve flow rates greater than 1 gallon per minute (GPM). Such pumping systems are over \$2000 cost. This variance is to allow use of a piston-pump (expensive) to purge

wells at Sky Harbor sites. The piston pump will produce flow rates of ~1.5 GPM and allow wells to be purged in 1 1/2 - 2 hrs. This is deemed as preferable to bailer purge which is likely to agitate water in the more costly bladder - 2 stage pump.

After completion of purging, wells will be sampled using 1/2" bailers in accordance to the sampling plan. ^{and through SOP # 57 SEC. ATTACHED} All down-hole wetted equipment will be decontaminated before and after introduction to a well in accordance with the sampling plan.

Wells at the Papago Military Reservation are likely to be "low yielding wells."

APPLICABLE DOCUMENT:

Final SI Field Sampling Plan, 161st Air Refueling Group, Arizona ANG, Sky Harbor International Airport, Phoenix, Arizona - September 1990.

CC: D. Bunn (HAZWREP) REQUESTED BY [Signature]

DATE 13 Feb 91

HAZWREP Files - 0449 APPROVED BY [Signature]

DATE 2/13/91

Project Manager

Quality Assurance Officer

DATE 14 Feb 91

DATE 2/20/91

HAZWREP PROJECT MGR.

Figure 6-1

Section No.: 6.0
Revision No.: 1
Date: 2/08/90
Page 4 of 8



INTERNATIONAL
TECHNOLOGY
CORPORATION

VARIANCE FORM

VARIANCE NO. 10

PROJECT NO. 409721 PAGE 2 OF 2

PROJECT NAME SKY HARBOR ANGB SI DATE 13 FEB 91

VARIANCE (INCLUDE JUSTIFICATION)

Such wells will be purged and sampled in accordance with the wrap position paper. No 2" diameter and sampling of long response wells (505 ATTACHED) No purging or discharge steps will be fully documented in the Sampling Plan. Purging will be accomplished using pumps down at 0.5 gpm or less. After one barrel of water has been purged, samples will be collected as soon as sufficient water returns to the well to collect a sample. A bailer will be used to collect samples.

APPLICABLE DOCUMENT:

CC:	REQUESTED BY _____	DATE _____
	APPROVED BY _____	DATE _____
	Project Manager	
	Quality Assurance Officer	
		DATE _____
		DATE _____

Document No.: DOE/HWP-100

Revision: 0

Date: July 1990

Page 5-1 of 5-4

**HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
STANDARD OPERATING PROCEDURE 5
GROUNDWATER SAMPLING WITH BAILERS**

1. OBJECTIVE

The purpose of this procedure is to define requirements for the collection of groundwater samples.

2. BACKGROUND

Methods used for the collection of groundwater samples include bailing and a variety of pumping techniques. Bailers are hollow cylinders with unidirectional (open up) check valves at the bottom end. Some bailers may also be closed or valved at the upper end. Bailers used in environmental applications are typically constructed of stainless steel, disposable nylon string, disposable monofilament polypropylene, Teflon-coated stainless steel wire, or Teflon, with stainless steel or Teflon being preferred. The bailer is lowered into the well on an acceptable line or coated wire line until submerged. The bailer is then retrieved to the surface for sample collection. This procedure describes groundwater sampling with bailers. For the best results, the sequence of sampling is from least to most contaminated wells. It is preferable for most sampling events using bailers to have dedicated bailers or enough bailers to last for 1 day's worth of sampling (normally 6 to 8/d).

3. RESPONSIBILITIES

Site Manager: The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and for verifying that groundwater samples are collected in accordance with this procedure.

Project Field Geologist: The Project Field Geologist is responsible for complying with this procedure, including sample collection, packaging, and documentation.

Document No.: DOE/HWP-100

Revision: 0

Date: July 1990

Page 5-2 of 5-4

4. REQUIRED EQUIPMENT

- For surface sample - bailer types.
- For specific depths - bailer types.
- Bottom-filling, bottom-emptying bailer (with bottom release, if needed) of the appropriate material.
- Clean rope or wire line of sufficient length for conditions.
- Appropriate sample containers with labels and preservatives, as required.
- Hard plastic or steel cooler with cold packs (or ice).
- Water-level meter and/or other water-level measuring device.
- Temperature, conductivity, pH, dissolved oxygen, and organic vapor meters, if required.
- Plastic sheeting.
- Decontamination supplies, as required
- Personnel protective clothing and equipment, if required by the site-specific health and safety plan.
- Latex or polyvinyl chloride (PVC) gloves.

5. PROCEDURE

The following steps must be followed when sampling groundwater with bailers:

1. Put on protective clothing and equipment as specified in the site-specific health and safety plan.
2. Prepare the site for sample acquisition by covering the ground surface around the wellhead with plastic sheeting. Arrange the required sampling equipment for convenient use. If on-site decontamination is required, arrange the necessary supplies in a nearby but separate location, away from the wellhead.
3. Open the well and note the condition of the casing and cap. Check for vapors using vapor analyzing equipment. Using a water-level meter, determine the static water level and depth to well bottom. Record this information in the field logbook or on the water sampling form.
4. Purge the well according to Hazardous Waste Remedial Actions Program (HAZWRAP) Standard Operating Procedure (SOP) 4, if not already accomplished. Allow the water level to recover to a depth at least sufficient for the complete submergence of the bailer without contacting the well bottom.
5. While the well is recovering from purging, decontaminate the bailer. If the bailer was decontaminated before arrival at the site, remove the protective wrappings. Securely attach the bailer to the line. The end of the line should also be secured.

Document No.: DOE/HWP-100

Revision: 0

Date: July 1990

Page 5-3 of 5-4

6. Arrange the sample containers in the order of use. Volatile organic analyte (VOA) samples, if required, will be obtained first, followed in order by semivolatiles (SVOA) and other samples.
7. Lower the bailer into the well. Do not allow the bailer to touch the casing. The bailer should enter the water slowly to prevent aeration, particularly when VOA and SVOA samples are being collected. Do not permit the bailer to contact the well bottom.
8. Retrieve the filled bailer to the surface. Do not allow the line to contact the ground. Hang the bailer from a bailer stand or other support, if available, or have an assistant hold it off the ground. The first bailer of water should be used as a rinse and then discarded. Immediately obtain any required VOA and SVOA samples by using the release valve to gently transfer water to the sample bottle. The sample bottle should be tilted when filling to prevent aeration. Check the filled vial for bubbles. The first volume of sample should be used as a rinse and then discarded, unless the sample bottles contain preservative. If sample filtration is required, it should be done as soon as possible, or after sample retrieval. If, after collecting VOA and SVOA samples, the total required sample volume is greater than the water remaining in the bailer, decant the water into a clean compositing container. The compositing container must have adequate volume to contain the entire volume necessary for collection. Again lower the bailer to collect water for additional sample volume, if needed.
9. When the composited sample volume is sufficient, decant water into the remaining sample containers. Add preservative (if needed), cap, seal, and properly label all containers. Place the filled containers in the cooler(s) immediately.
10. Record sample types and amounts collected, and time and date of collection in the field logbook and on the groundwater sampling form per HAZWRAP SOP 1, Parts A and B, respectively. Prepare chain-of-custody and analytic request documents as required by the project quality assurance plan.
11. Decontaminate sampling equipment according to HAZWRAP SOP 14.
12. Clean up the area and place disposable materials (plastic sheeting, gloves, Tyvek) in the designated receptacle. Close and lock the well cover.

6. RESTRICTIONS/LIMITATIONS

Obtain on-site data such as temperature conductivity, pH, or dissolved oxygen measurements after samples have been collected. This may require additional time for well recovery.

Document No.: DOE/HWP-100

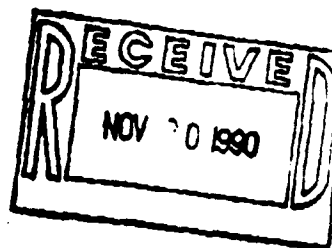
Revision: 0

Date: July 1990

Page 5-4 of 5-4

7. REFERENCES

- Driscoll, F. G., *Groundwater and Wells*, Second Edition, St. Paul, Minnesota, Johnson Division, 1986.
- U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, 1987.
- U.S. Environmental Protection Agency, *Manual of Water Well Construction Practices*, EPA/570/9-75-001, 1975.



POSITION PAPER NO. 2

DEVELOPMENT AND SAMPLING OF LOW RECHARGE WELLS

Hydrogeology Support Group
Hazardous Waste Remedial Actions Program*
Martin Marietta Energy Systems, Inc.
Oak Ridge, Tennessee 37831-7106

1. INTRODUCTION

A low recharge well can be defined as a well that does not recover to 90% of its static water level within 6 to 8 h after being purged. There are many other definitions for low recharge formations; however, this is the one that the Hazardous Waste Remedial Actions Program (HAZWAP) will use in its discussion of this issue. Low recharge formations can be found in most of the following environmental scenarios: fine-grained, unconsolidated material such as clay, silt, shale, or clay in the interstices of larger-grained material; or igneous and metamorphic rocks. Under the above conditions, four problem areas surface when it is the task of the hydrogeologist to obtain a representative sample of the groundwater from these types of aquifers. They are: how do you reduce siltation within the well, how do you develop a low recharge well, how do you purge a low recharge well, and when do you sample for volatile organics after purging a low recharge well?

In the following document, we will discuss these issues and present the most recent discussions with regard to these issues. It is the intent of this position paper to make the hydrogeologist aware of the problems associated with low recharge wells and to provide some guidance on the above issues. For the purpose of this position paper, only low recharge aquifers composed of fine-grained, unconsolidated materials will be discussed.

2. SILTATION AND DEVELOPMENT

2.1 STATEMENT OF THE PROBLEM

Siltation and development problems are usually relegated to unconsolidated sediment aquifers. These are generally not problems associated with slow recharge in consolidated sedimentary, igneous, or metamorphic environments. Both of these issues (i.e., siltation and development) will be

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discussed concurrently since, in general, they are related issues (i.e., siltation is largely a problem of ineffective development procedures and/or well construction techniques).

Siltation is the process whereby, during well construction and/or development, small-sized aquifer material (generally smaller than that retained on a #50 US standard sieve) can be found within the well casing, making the water sample turbid. It is of note that this same grain size range (i.e., less than #50 standard sieve size) makes up over 30% of the aquifer material, which is the principal reason why the formation is a slow recharger. This material ends up in the well casing usually by two methods. In the first, the fine-grained materials are introduced into the well casing directly during well installation. This usually occurs at the same time as the well screen, filter pack, and riser pipe are placed at the bottom of the borehole. From the time the borehole drilling is complete and the well is placed, groundwater will move up into the auger flights, carrying with it an associated amount of aquifer material due to hydrostatic pressure. The screen, casing, and filter pack are introduced directly into this "soup", thereby introducing the fine-grained material directly into the casing. Also during placement, the aquifer material may become integrated with the filter pack material during placement of the filter pack.

The second siltation problem area occurs during development. In monitoring well construction, the purpose of the design of the filter pack is to retain 95 to 100% of the aquifer material. In general, this is not always accomplished because all too often the well screen size and filter pack size are selected before the field investigation (i.e., during the work plan development stage). During this stage, when they suspect slow recharge aquifers, 10-slot screens with Ottawa #1, Morie #1, or equivalent filter pack material are selected in advance of actual field information. The development procedure, therefore, must clean out the residual materials in the well casing and must also pull the fine material out of the filter pack since it was placed and commingled with aquifer material during placement. Therefore, due to poor construction design, new aquifer fine-grained material is pulled into the casing during development because the filter pack material cannot retain 95 to 100% of the aquifer material.

This represents a synopsis of the siltation and development problems associated with monitoring well construction techniques. The following section will discuss some of the more recent published articles relevant to these issues.

2.2 PUBLISHED APPROACHES TO SILTATION AND DEVELOPMENT

2.2.1 Well Construction Methods

The key question to be answered in assessing well construction methods in low-yield aquifers is, "Can well-designed construction techniques improve the quality and quantity of groundwater samples from a low recharge aquifer?". In review of the literature, the following information is submitted for evaluation:

- o In a study conducted by Paul, Palmer, and Cherkauer (1988), a series of ten wells were placed in glacial tills. Of these wells some had been installed wet (the well was not cleaned out of excess loose material before well placement) because of delays in setting the screens, and some had been installed dry (the loose materials had been removed from the borehole). Of the wells installed wet, the wet wells exhibited 50 to 200 times greater turbidity than wells installed dry.
- o In an article in Groundwater Age (Wehrmann, 1983), a method that can be used in clayey environments, where an open borehole can be sustained, is to pump water down the inside of the monitoring well casing, out the screen, and up the annulus of the borehole. This should be done both before and after the gravel pack is emplaced to free fine-grained material from the surface of the borehole and the gravel pack materials. Circulation should be continued until the water coming up the annulus looks clear (Wehrmann, 1983).
- o According to Nielson (1988), the continuous-slot, wire-wound screen is more effective in preventing formation materials from becoming clogged in the openings. It allows particles slightly smaller than the openings to pass freely into the well without wedging in the opening, making these intakes nonclogging.
- o In an article by Gass (1989), drilling methods and well construction techniques must be adapted to minimize borehole damage before the installation of a well screen (commonly referred to as "skin effect") and a filter pack, or at least to correct borehole damage before installation of the well screen and filter pack. In addition, it must be understood that the effectiveness of well development is going to be extremely limited in alleviating this effect. To reduce this effect, he suggests several techniques: (1) boring the zone representing the screened interval with a 3- to 5-in. Shelby tube, (2) scratching the sides of the borehole with an oversized brush or wire to eliminate the smear effect, and/or (3) developing the low-recharge well with a bailer or small-diameter surge block to achieve gentle agitation of the filter pack so that any residual fine material that may have been incorporated into the filter pack during its emplacement can be removed.

2.2.2 Well Construction Materials

In assessing well construction materials, the following information is submitted for evaluation:

- o In an article by Gass (1988), Gass states that the filter pack should be graded, fine to medium sand. Because of the gradation, the effective size of the filter pack will be quite small and yet will still be orders of magnitude more permeable than the formation and will not restrict well yield. In almost all cases, a 10-slot screen will retain 80% to 90% of the filter pack.

- o In an article by Nielson (1988), the use of an artificial filter pack in a fine-grained material allows the screen slot size to be considerably larger than if the screen were placed in without the filter pack. This is particularly true where fine slot sizes, which are designed to hold out formation materials, are either impractical or not commercially available. The larger screen slot size afforded by the filter pack allows for the collection of adequate volume of sediment-free samples (Nielson, 1988).
- o Paul, et al. (1988), states that the function of the filter pack is to stabilize the borehole and to prevent formation materials from entering the well. They recommend that the proper size of filter pack and screen can be chosen from the grain size distribution curve of the formation by applying the method outlined by Driscoll (1986). In addition, he states that commonly available well screens and sand packs were not capable of filtering out clay-sized particles found in fine-grained glacial tills. The optimal well design would require a silt-sized sand pack and a very fine-meshed screen (<0.05 mm). In addition, the wells within his study were constructed of different types of screens (slotted and continuous). From this condition he observed in his glacial till study that surging of the wells that had standard factory slot screens pulled more formation material through the sand pack and into the screen than wells that had continuous-slot screens. There were no substantial differences in the turbidity measurements between the three types of well screens that had been bailed.

From the information collected, several issues were not discussed. One of these issues is the use of sumps in well construction in low-yield unconsolidated aquifers. It has been a standing practice during the past 5 years that sumps be used in well construction in low-yield aquifers. A sump is a piece of blank casing placed below the screen and is designed to retain and separate the siltation materials (accumulated fine-grained material settling out of suspension) from the screened interval. This device is used primarily to keep the entire surface area of the screened interval open to receive groundwater.

Another issue that has become a standard practice is to ensure an appropriate filter pack thickness. All too often, particularly in shallow groundwater wells (i.e., those less than 50 ft), a 2-in. well is placed in a nominal 4-in. borehole. It is generally agreed that the filter pack thickness should equal the well diameter and that it should be tremied into place. The reasoning behind this position is that an insufficiently large filter pack thickness will not retain the large volume of fine-grained material trying to enter the well screen and that a sufficient volume is needed to effectively retain or retard this condition.

In addition to the above, Johnson Screens has developed a new screen specifically designed for low-yield aquifers. This new well screen is called Channel Pack and is basically two continuously wrapped screens separated by a glass bead filter pack. This screen has not been extensively field tested, so its advantages and disadvantages have not been well established.

2.2.3 Recommendations

Based on the above information, the following construction methods and material specifications are recommended:

- o Filter pack thickness around the well screen should be at least the same thickness as the diameter of the casing/riser.
- o Sumps should be placed below the well screens to act as a sediment trap for all low-yield aquifer wells.
- o Well screens should be of the continuous slot variety.
- o Well screens, casing, and filter pack material should be placed in dry wells (i.e., the loose "soupy" material within the drill casing should be cleaned out or removed before materials placement).
- o For optimum design, the filter pack should be graded according to the aquifer particle size distribution to ensure that the largest percentage of the aquifer material will be retained by the filter pack.
- o Well screen slot size should be sized to the filter pack. In most instances, the filter pack should be sized to retain 95 to 100% of the aquifer material.

3. DEVELOPMENT

The main purpose for the development of a well, any well, is to produce a turbid-free sample (i.e., to rid the filter pack, screen, and well casing of the small particles that remain that are the direct result of the installation procedure or design). Beyond this, the goal for wells in the water well industry differs significantly from the hazardous waste industry. In the water well industry, the purpose of well development is to obtain maximum yield with the least turbidity for the purpose of water consumption. In the hazardous waste industry, the purpose of development is to obtain a turbid-free sample for the purposes of chemical analysis in the parts per billion range. Wells designed for pump testing are the exception since increasing well efficiency may improve the quality of the pump test data. There is a significant difference between these two goals. In the hazardous waste industry, constructing wells for the purpose of high yields tends to be a secondary requirement.

Common methods of well development in fine-grained materials are pumping, surging, bailing, and the use of compressed air to "blow out" the well. All of these, or combinations thereof, are acceptable methods within the water well industry; however, all do not carry the same level of confidence within the hazardous waste industry. The following is a

presentation of recent information from literature addressing this issue.

3.1 PUBLISHED INFORMATION ON DEVELOPMENT

- o In the development of wells in glacial tills (Harman, 1988), a stainless steel submersible pump was used. The pump was lowered by hand to decrease the turbidity of the water. The pumping rate was slow and continuous, with a low volume of water being pumped. This pulled the fine-grained material from the sand pack. The silt settled to the bottom, and water samples could be taken from the top of the water column. Bailing could be used instead of pumping to develop the well.
- o In tight formations, well development must be sufficiently vigorous to remove fine-grained particles without damaging the well (Marbury and Brazie, 1988). The turbidity of the water needs to be reduced.
- o According to Giddings (1985), the steep hydraulic gradient caused by dewatering the well during pumping causes turbulent flow in the aquifer and in the gravel and sand pack, and this results in a very turbid sample. A surge and block bailer has been successfully used in developing low recharge wells.
- o According to Gass (1988), when an attempt is made to develop a silt or clay formation, the formation will not bridge, and greater amounts of the formation will be pulled into the well. The same type of surge energy reaches the formation when a well is purged and sampled with a bailer that fits snugly within the well or when a pump that just fits in a well is rapidly inserted or removed from the well. The key to achieving clean samples then is to reduce or eliminate surge energy from reaching the formation.
- o The following study was performed by Paul, Palmer, and Cherkauer (1988). In this case, some wells installed in fine-grained glacial tills were surged for 10 min and then bailed along with wells that were bailed only. Water was collected from the screened intervals for turbidity analysis. The hydraulic conductivity of the formation was sufficiently low that no significant well recovery occurred between the time the well was bailed and the sample was taken. Many of the samples contained a considerable amount of sediment. Bailings of two wells indicated a large amount of clay sediment at the bottom, which was easily agitated, especially when the bailer touched bottom. The wells were then pumped dry to reduce the amount of sediment and were allowed to recover. When samples were taken 4 months later, the turbidity had been reduced in all but one well.
- o Surging of the wells increased the turbidity. The turbidity was 50 to 100 times greater than that in wells that were bailed. Sand pack and screens had little effect on the amount of turbidity. In surged wells, the average turbidity stayed the same between the two sampling periods. In the bailed wells the turbidity decreased fourfold (Paul, Palmer, and Cherkauer, 1988).

- o In the restoration of clogged wells installed in glacial tills, jetting was used, and fine sand, silt, and clay are washed out of the water-bearing formation. The turbulence created by the jet brings these fine materials back into the well through screen openings above and below the point of operation (Gass, 1985).

3.2 DEVELOPMENT RECOMMENDATIONS

Based on the above information and in consideration of the procedures previously recommended for well design and installation, the following development procedures are recommended:

- o Remove any sediment that may exist within the well casing. This may be accomplished by using a sand bailer (which most drill rig operators are familiar with for larger diameter wells), by using pump and surge, or by using air lift techniques to remove the sediment in the sediment trap.
- o Ideally, the first attempt should be to develop a low yield well by pumping and/or removing water at a rate equal to or less than the recharge rate of the aquifer. This may be accomplished using peristaltic pumps, bailers, or bladder pumps for some aquifers. The object of this methodology is to induce water into the well at a very low but constant rate until the water is relatively clear. (NOTE: If bladder pumps are to be used, removing the silt from the well is critical because of the potential damage to the bladder.)
- o If the above techniques cannot be accomplished and the wells are pumped to near dryness even with slow rates of water removal, the next recommended option is to use a closed-bottom bailer in a pump-and-surge-type scenario. Under this scenario, as the bailer enters the well, the bailer itself acts as a surge block and forces water out through the screen, dislodging silt and clay size particles from the screen and the filter pack with the intention of the particles returning through the screen to be removed during the bailing operation. The surging activity, however, should not be so vigorous as to extend the surging action into the aquifer material itself. If during this process the well is pumped to dryness, the above procedure may have to be repeated one to two additional times to obtain a sample that is relatively sediment free. A specific application of this approach is to develop the well in stages (2 to 3 ft at a time, from the bottom up). In this the surge stroke should not exceed the surged interval.
- o At the completion of the development of a well, a well recovery test should be performed. This test is similar to a rising head slug test. These data will assist the field hydrogeologist in the development of other wells and in the scheduling and planning of

purge and sample activities. It is not implied, however, that well recovery tests should be conducted on every well. The discretion of the use of this test is held within the purview of the field hydrogeologist and the HAZWRAP project team.

4. PURGING AND SAMPLING

4.1 PURGING

Perhaps the most critical component of collecting a representative sample of the aquifer water occurs during the purging process. The main purpose of purging a well is to remove the stagnant water from the well casing and borehole and to replace it with groundwater that more accurately reflects chemical conditions within the aquifer. A lot of discussion has focused on this issue. The rationale for purging is to help remove fine-grained particles in the well and sand pack that may potentially enter the well screen and the sample (Paul, Palmer, and Cherkauer, 1988). (NOTE: All operations need to be performed with materials and equipment that have been thoroughly cleaned to avoid introducing contamination into the well. This is especially critical in low-yield wells because even a minute amount of contaminant may result in relatively high concentrations in samples.)

The following is a presentation of discussions on this issue that have occurred in technical publications over the past several years:

- o According to the Wisconsin Department of Natural Resources Guidance (Lindorf, Feld, Connelly, 1987), the most straightforward method for removing all of the stagnant water from wells screened in low permeability formations is to pump or bail the well dry. This procedure may be the best way to ensure that all of the stagnant water in the well has been exchanged with water from the aquifer. After purging, the well should be allowed to fully recover and can be purged a second time if needed.
- o The Environmental Protection Agency (EPA) Technical Enforcement Guidance Document (1986) is similar to this. It states that when low-yield wells are being developed, they should be pumped to dryness once. If the recharge rate of the well causes the formation water to vigorously cascade down the intake screen and accelerate the loss of volatiles, the well should not be pumped dry. If this is anticipated, three casing volumes should be purged from the well at a rate that does not cause the recharge water to be excessively agitated.
- o If a monitoring well is drained completely during purging, the formation water will be exposed to the atmosphere as it enters the well. This may cause a 10% loss of volatiles within 5 min and a 70% loss within 1 h. Protocols should avoid draining the well and any unnecessary exposure of the sample to the atmosphere, especially when combined with turbulence (McAlary and Barker, 1987).

- o If the sand pack around screens is drained during purging or flushing, the formation water will flow into the well by cascading through the headspace in the dewatered sand filter pack. Some volatilization can be expected to affect the groundwater even before a sample can be collected (McAlary and Barker, 1987).
- o The amount of recharge may limit the amount of sample that can be collected. Frequent purging will likely dewater the saturated zone, causing the well to go dry for a period of time. In wells that require a very long period of time to recharge, the interval between sampling events may not be sufficient to allow full recovery to static water-level conditions. In such cases, an annual or semiannual sampling event may be more appropriate than quarterly events (Marbury and Brazie, 1988).
- o The results of a laboratory standing-column volatilization test by McAlary and Barker (1987) showed that losses will reach 10% within 1 h and 99% in 1 month. The standing water should therefore be thoroughly purged before sampling. In the context of a sampling event, it may be acceptable in moderately low permeability materials to return for sampling of volatile organics several hours after purging, provided that the calm surface of the water in the casing was the only exposure of the sample to headspace.

4.2 SAMPLING

The problems of purging and sampling low recharge wells are mutually related events. The type of purging a field team performs may affect the sampling effort. In addition, within the literature, it is not clear as to the best time to sample for volatile organics. The following are submitted for evaluation and review:

- o In low-yielding bedrock aquifers, wells may be pumped dry by removing only one bore volume of water. If the water-bearing fractures are located just below the static water table level, the well will refill by cascading water entering the bore and falling to the bottom. This alters the dissolved gases in the water and increases the dissolved oxygen content. Many monitoring parameters are sensitive to this alteration, and it can lead to misrepresentative sampling (Giddings, 1985).
- o A water-level monitoring period of several hours or days may be required to determine whether the well bore is making water or to determine if the water level will return to static water-level conditions. In these instances, it may be possible to remove only one casing volume before sampling (Marbury and Brazie, 1988).

- o Samples should be collected as soon as there is a sufficient amount of water in the well bore in order to get a sample that is representative of the formation water (Lindorf, Feld, Connelly, 1987).
- o According to the EPA Guidance, as soon as the well recovers, the order of sampling should be pH, volatiles, oxidation-reduction, semivolatiles, pesticides/polychlorinated biphenyls (PCBs), metals, and inorganic compounds. For wells with a recovery time of greater than 3 h, samples should be taken in order of their volatility as soon as there is a sufficient volume of water available for a sample for each parameter. Parameters that are not pH sensitive or subject to volatilization should be taken last.
- o In the sampling of naturally purged wells (Robin and Gillham, 1987), results indicated that a representative sample could be obtained from the screened interval through the use of dedicated sampling device, such as a syringe sampler. The intake would need to be located near the bottom of the screened interval. The volume of the sample would have to be significantly less than the volume of the screened interval. Some contamination could result from displacement of water by the sampling device. In this study, as screen lengths became shorter (screen lengths of 1, 2, and 5 ft), the first samples were progressively more contaminated.
- o In a recent article by Herzon et al. (1988) eleven 2-in. OD stainless steel wells were developed using bailers and a diaphragm pump. Bailers were used to extract water and to act as surge blocks to draw in fine materials. This procedure was repeated four times for each well. The diaphragm pumps were used to pump the wells to dryness so that a rising-head test could be performed on each well. Samples were retrieved at several different times after purging. The final conclusions were that wells in low-yield aquifers should be purged before sampling and that concentrations of volatile organics in the sample collected 4 h after purging contained the highest volatile organic concentrations.

5. EQUIPMENT FOR DEVELOPMENT, PURGING, AND SAMPLING

To minimize the introduction of contamination into the well, positive gas displacement Teflon bladder pumps are recommended for purging wells. Teflon or stainless steel bailers are also recommended purging equipment. Where these devices can't be used, peristaltic pumps, gas-lift pumps, centrifugal pumps, and venturi pumps may be used. Where a sampling device requires an intake line, or discharge line, the composition of the line should be Teflon, polyethylene lined with Teflon, or polyethylene. Where a sampling device requires a support line to the surface (as in bailers), the support line should be single-strand, stainless steel wire, Teflon-coated stainless steel wire (single strand or braided), or a stainless steel leader attached to monofilament polyethylene line.

Pumping rates for peristaltic pumps are typically less than 1500 mL/min. Other types of pumps produce volatilization and high-pressure differentials, causing variability in the analysis of pH, specific conductance, metals, and volatile organic samples. They are, however, acceptable for purging wells (EPA Guidance, 1986).

The equipment required for jet development includes a jetting tool with two or more nozzles, a high-pressure pump, a high-pressure hose, and a supply of water. The nozzles should be evenly spaced on the jetting tool (Gass, 1985).

The valve-type plunger could be used in tight formations because it has a lighter surging action. A bailer can be used along with the plunger (Gass, 1985).

In Paul, Palmer, and Cherkauer, the surging process (in fine-grained glacial tills) was performed with a length of polyvinyl chloride (PVC) electrical conduit fitted with an oversized rubber stopper. The rubber stopper was small enough to allow passage through the well but large enough to force water before it. A peristaltic sampling pump was used to remove the bottom sediment from the monitoring wells.

In a study by Griffin et al. (1988) on the collection of volatile organics from fine-grained materials, samples were collected using a double-check valve, Teflon bailer with a bottom-draining device. For shallow, small-diameter wells with low yields, evacuation of the well by a bailer is feasible. Syringes can also be used to sample water from low hydrostatic head aquifers because they only remove a small volume of water from the well (Nielson, 1985).

6. RECOMMENDED PROCEDURES FOR PURGING AND SAMPLING

The following purge and sample procedures are based on a review of the information provided above, known characteristics of monitoring well recharge and well dynamics, and the best available technology. The succeeding information is provided to act as a starting point with regard to planning and execution of sampling activities within low recharge environments. It is understood that as field activities commence, minor revisions to the purge and sample activities may be required based on site-specific information; however, the following scenario should be used and planned for during the early stages of field activity development.

The following procedures are recommended for purging and sampling of low recharge aquifers:

- o As a general rule, under low recharge conditions, purge and sample activities should not occur for a minimum of 7 d after well development. This period may be extended, dependent upon very low recharge conditions and varying site conditions.

- o Purging and sampling are considered by HAZWRAP to be mutually inclusive activities (i.e., they are not separate events). Therefore, the common field activity of purging all wells first then sampling is not considered to be the best available procedure. Purging and sampling should be considered, in terms of schedule, as one event.
- o Purging begins with placing the pump or purge device at the top of the water column to remove the water from the well casing and borehole from the top down.
- o Purge rates should be at a value less than that indicated from the well development recharge rate recorded at the conclusion of well development. Under low recharge conditions, this rate will rarely exceed 0.5 gal/min. This low purge rate will permit the water within the casing and borehole to exchange without pumping the well to dryness or appreciably depressing the static water level.
- o If the above condition cannot be met, the entire volume of water within the well casing and borehole should be removed at the rate determined above. If it is already known that the well can be pumped down without appreciable recharge, the rate specified above should not be exceeded. Excessive pumping will only cause turbidity problems when eventual recharge and sampling begin. (NOTE: As a reminder, under the well construction recommendations, each well will exhibit a 2- to 5-ft sediment trap to be located below the screen. Therefore, the sediment trap should be removed of built-up sediment before actual purging and sampling).
- o If the well does not recover to 90% of its static water level within 6 to 8 h, only one borehole volume need be removed. If the well recovers in less time, purge activities should be repeated at least one more time. At the conclusion of the initial purge activities, if significant fines have accumulated in the sediment trap, these fines should be removed before the second purge activity.
- o Sampling from wells in which the static water level was not appreciably depressed is to occur immediately after purge activities are completed (within 3 h as a general rule). Sampling from wells, in which the water was completely removed from the well or the recovery time exceeds 3 h, will occur (for volatiles and pH and oxidation-reduction sensitive analytes) when the water level has reached a point above the bottom of the screen such that a sufficient sample can be retrieved. Sampling for other nonsensitive analytes may occur at some point later as the well has had time to more completely recover and provide sufficient sample. If sufficient sample has not become available within 24 h, the HAZWRAP Project Manager should be immediately informed so that a decision can be made as to the disposition of this condition.

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VARIANCE FORM

VARIANCE NO. 11

PROJECT NO. 469721.02.05

PAGE 1 OF 1

PROJECT NAME SKY HARBOR

DATE 9 APR 91

VARIANCE (INCLUDE JUSTIFICATION)

The purge requirements for sampling groundwater in the Sky Harbor FSP require 3 well volumes be removed prior to sampling monitoring wells, FSP Section 5.7.4.1. Following HAZWRAP SOP #4 ^{to calculate the well volume,} this amounts to approximately 150 gallons per well. A piezometer (2-inch diameter) is being sampled for additional GW quality information. Because of the smaller diameter, the sampling pump will not fit into the piezometer screen. This variance requests the use of HAZWRAP SOP #4 ^(SEE ATTACHMENT) INDICATOR PARAMETER METHOD OF WELL PURGING (Section 5.3) ^(SEE ATTACHMENT) be used in place of the 3 volume requirement. The variance is requested because of the length of time that will be required to remove 150 gallons from a 2-inch piezometer using a 1-inch I.D. Bailor.

Monitoring wells sampled to date indicate parameter (PH, etc) stabilization is achieved within 1 well volume, thus, the need for purging beyond 1 well volume is not indicated. 1 well volume will be removed from the subject piezometer and parameter stabilization will be used prior to sampling. The indicator parameters to be measured are those discussed in Sec. 5.7.4.2. No adverse effects on data quantity or quality are expected to result from this variance.

This variance applies only to the sampling of 2-inch piezometers.

APPLICABLE DOCUMENT:

Final Site Investigation Field Sampling Plan 145R Air Refueling Group, Arizona Air National Guard, Sky Harbor International Airport, Phoenix, Arizona. Sept 1990 Section 5.7.4.1

CC: David Bunn *DB*
HAZWRAP Files - 0449

REQUESTED BY Steve Jones

DATE 4-9-91

APPROVED BY David Bunn

DATE 4/9/91

Project Manager

Don Mack
Quality Assurance Officer

DATE 10 APR 91

Robert W. Jones
HAZWRAP Project Manager

DATE 4/15/91

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
STANDARD OPERATING PROCEDURE 4
WELL DEVELOPMENT AND PURGING

1. OBJECTIVE

The objective of this procedure is to define the procedural requirements for well development and purging.

2. BACKGROUND

Monitor wells are developed to remove skin (i.e., near-well-bore formation damage) and to settle and remove fines from the filter pack. Wells should not be developed for 24 h after completion when a cement bentonite grout is used to seal the annular space. However, wells may be developed before grouting if conditions warrant. Wells are purged immediately before groundwater sampling to remove stagnant water and a sample representative of groundwater conditions. Wells should be sampled within 3 h of purging (optimum) to 24 h after purging (maximum, for low recharge conditions).

3. RESPONSIBILITIES

Site Manager: The Site Manager is responsible for ensuring that field personnel are trained in the use of this procedure and for verifying that development and purging are carried out in accordance with this procedure.

Project Field Geologist: The Project Field Geologist is responsible for complying with this procedure.

4. REQUIRED EQUIPMENT

- Pump, pump tubing, or bailer and rope or wire line.
- Power source (e.g., generator), if required.
- Water-level meter or weighted surveyor's tape.
- Temperature, conductivity, pH, and/or dissolved oxygen meters (for Sect. 5.2 below).
- Personnel protective equipment as specified in the site-specific health and safety plan.

- Decontamination supplies, if required on-site.
- Disposal drums, if required.

5. PROCEDURES

5.1 WELL DEVELOPMENT

The following steps must be followed when developing wells:

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom of the casing.
4. Prepare the necessary equipment for developing the well. There are a number of techniques that can be used to develop a well. Some of the more common methods are bailing, overpumping, backwashing, mechanical surging, surge and pump, and high-velocity jetting. All of these procedures are acceptable; however, final approval of the development method rests with the appropriateness of a specific method to the site and the Hazardous Waste Remedial Actions Program (HAZWRAP) project manager.
5. For screened intervals longer than 10 ft, develop the well in 2- to 3-ft intervals from bottom to top. This will ensure proper packaging in the filter pack. Note: It is good practice to develop all screened and filter-packed wells in stages.
6. Continue well development until produced water is clear and free of suspended solids. Record pertinent data in the field logbook and on appropriate well development forms per HAZWRAP SOP 1, Parts A and B, respectively.
7. Remove the pump assembly or bailers from the well, decontaminate (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

5.2 VOLUMETRIC METHOD OF WELL PURGING

The following steps should be followed when purging a well by the volumetric method:

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom of well string. Calculate the well volume (volume of water within the well bore) using the following formula (or equivalent):

$$7.4805 \left(\frac{D^2 \pi}{4} \right) dH = \text{volume (in gallons)},$$

where

D = casing diameter in feet. (NOTE: This equation is used for grouted wells with short screens. For wells with long screens and/or ungrouted wells, then D = borehole diameter in feet.)

dH = the distance from well bottom to static water level in feet.

Note these data and calculations in the field logbook.

4. Prepare the pump and tubing, or bailer, and lower it into the casing.
5. Remove the number of well volumes specified in the project plans. Generally, three to five well volumes will be required. In low-recharge aquifers, the well will commonly pump or bail to dryness before three well volumes of water are removed. If this is the case, there is no need to continue with purging operations (HAZWARP Position Paper No. 2). Record pertinent data (e.g., water volume) in the field logbook.
6. Remove the pump assembly or bailer from the well, decontaminate it (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

5.3 INDICATOR PARAMETER METHOD OF WELL PURGING

1. Put on personnel protective clothing and equipment as specified in the site-specific health and safety plan.
2. Open the well cover and check the condition of the wellhead, including the condition of the surveyed reference mark, if any.
3. Determine the depth to static water level and depth to bottom. Lower the probe(s) of the indicator meters (e.g., temperature, conductivity) into the water to a point near (but not at) the well bottom or use the flow-through system for indicator parameter measurement. Alternatively, set up surface probe(s) (e.g., pH, dissolved oxygen) at the discharge orifice or dedicated probe port of the pump assembly or within the flow-through chamber. Allow subsurface probe(s) to equilibrate according to manufacturer's specifications. Record the equilibrated readings in the field logbook together with the time.
4. Assemble the pump and tubing, or bailer, and lower into the casing.
5. Begin pumping or bailing the well. Record indicator parameter readings at predetermined intervals. Maintain a record of the approximate volumes of water produced.
6. Continue pumping or bailing until indicator parameter readings remain stable within $\pm 10\%$ for three consecutive recording intervals. Purging should continue until the discharge stream is clear. In low-recharge aquifers the well may pump or bail to

dryness before indicator parameters stabilize. In this case, there is no need to continue purging. Record pertinent data (e.g., water volume) in the field logbook.

7. Remove the pump assembly or bailer from the well, decontaminate (if required), and clean up the site. Lock the well cover before leaving. Dispose of produced water as required by the project work plan.

6. RESTRICTIONS/LIMITATIONS

Where flammable free or emulsified product is expected or known to exist on or in groundwater, use only intrinsically safe electrical devices and place portable power sources (e.g., generators) 50 ft or more from the wellhead and disposal drums.

7. REFERENCES

- Driscoll, F. G., *Groundwater and Wells*, Second Edition, St. Paul, Minnesota, Johnson Division, 1986.
- U.S. Environmental Protection Agency, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, 1987.
- U.S. Environmental Protection Agency, *Manual of Water Well Construction Practices*, EPA/570/9-75-001, 1975.



CHRONOLOGIC LIST OF PROJECT VARIANCES

PROJECT NAME SKY HARBOR

[illegible]



INTERNATIONAL
REGULATORY
COOPERATION

NONCONFORMANCE REPORT

PROJECT AZANG Sky Harbor

PROJECT NO. 409721

NR NO. 1

PAGE 1 OF 1

DATE: 01/18/91

1. NONCONFORMANCE DESCRIPTION

Problem: Poor recovery of some peaks or completed loss of peaks for start of day standard analysis.

Criteria: Per SOP, start of day calibration will be ran and acceptable recovery occur for all compounds.

Impact: Has no impact on previous analytical data, but will have significant impact on any future data if not corrected.

IDENTIFIED BY: D. Peery DATE: 01/17/91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

Cleaning of lamp and detector head 01/17, 01/18, 01/19 and recalibrate.

TO BE PERFORMED BY: D. PEERY

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

[Signature]
Project Manager

1/17/91
Date

[Signature]
Quality Assurance Manager

1/24/91
Date

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

GC was replaced 01/19/91 with a new instrument from a different vendor.

5. CORRECTIVE ACTION COMPLETE

PERFORMED BY: D. Peery

DATE: 01/19/91

VERIFIED BY: [Signature]

DATE: 1/19/91

CC: PROGRAM MANAGER

PROJECT MANAGER

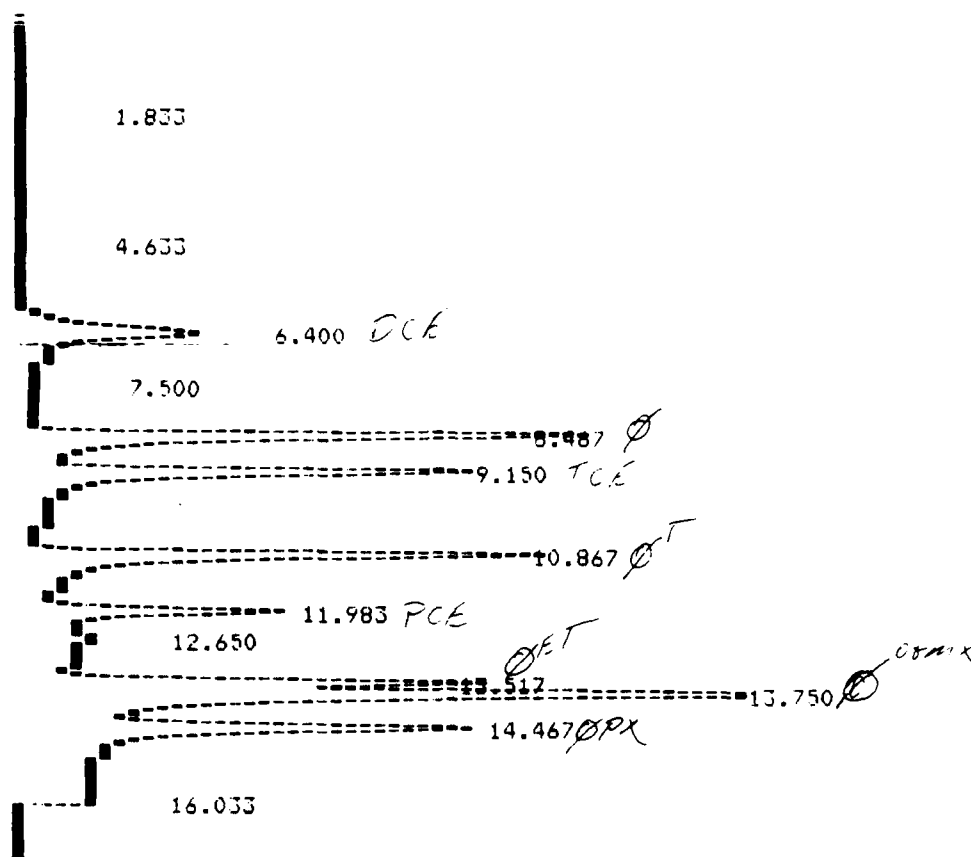
QUALITY ASSURANCE MANAGER

QUALITY ASSURANCE COORDINATOR

CENTRAL FILES

OTHER:

FULLSCALE MILLIVOLTS 256



SKYHARBOR PHOENIX AZ, PROJECT E 409721
DATA FILENAME C:STSTD4.PRN
16:24:23 01-19-1991
START STANDARD DAY 4 @ 3uL S + 3uL BTEX

RET.TIME	PEAK AREA	HEIGHT	AREA%	NORM%	EXT.STD	INT.STD.	PEAKNAME	RET
6.400	1401.95	64.45	8.3007	9.61	1401.95	1401.9501		6.40
8.467	2602.07	222.35	15.4064	17.84	2602.07	2602.0691		8.47
9.150	2059.98	174.75	12.1968	14.12	2059.98	2059.9827		9.15
10.867	2580.66	204.55	15.2796	1.89	275.12	275.1227	BENZENE	10.87
11.983	1057.73	99.75	6.2626	7.25	1057.73	1057.7277		11.98
12.650	280.54	26.10	1.6611	1.92	280.54	280.5441		12.65
13.517	1550.76	177.85	9.1818	10.63	1550.76	1550.7592		13.51
13.750	3431.59	323.75	20.3179	23.53	3431.59	3431.5930		13.75
14.467	1667.60	172.85	9.8736	11.43	1667.60	1667.6001		14.47
16.033	153.81	27.90	0.9107	1.05	153.81	153.8100		16.03

DILUTION FACTOR = 1
TOTAL NUMBER OF PEAKS DETECTED 14 AREA REJECT= 75
TOTAL NUMBER OF IDENTIFIED PEAKS 1 USING SKYHARB.CFT .CFT
TOTAL UN-CORRECTED PEAK AREA 16889.5
TOTAL NORMALIZED PEAK AREA 14583.97
INTERNAL STANDARD CORRECTION FACTOR 1
INTERNAL STANDARD PEAK NAME AT TIME 1
TOTAL HYDROCARBONS (total peak area using TPH cal.curve) 31979 NANOGRAMS

INTERNATIONAL
TECHNOLOGY
CORPORATION**NONCONFORMANCE REPORT**PROJECT AZANG Sky HarborPROJECT NO. 409721NR NO. 2PAGE 1 OF 1DATE: 01/30/91**1. NONCONFORMANCE DESCRIPTION**

Problem: Significant shifting of retention time and loss of resolution for ethylbenzene and xylenes.

Criteria: Per SOP, calibration should show consistent retention time and separation of peaks.

Impact: Samples ran during time GC was out of control, some tentative identification and quantification of compounds based upon information from retention time data obtained from extra standard runs daily. Samples will be rerun when back on line.

IDENTIFIED BY: Cara Huston DATE: 01/17/91**2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES**

Check temperature program, carrier gas flow rate, carrier gas pressures, connectors for leaks, cycle through program shooting standards monitoring standards data 01/29 through 02/01/91.

TO BE PERFORMED BY: Cara Huston**3. APPROVAL FOR PROPOSED CORRECTIVE ACTION**[Signature]
Project Manager1/18/91
Date[Signature]
Quality Assurance Manager01/20/91
Date**4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)**

Same as above.

5. CORRECTIVE ACTION COMPLETEPERFORMED BY: Cara Huston

01/29/91-02/01/91

DATE: _____

VERIFIED BY: [Signature]DATE: 01/20/91

CC: PROGRAM MANAGER

PROJECT MANAGER

QUALITY ASSURANCE MANAGER

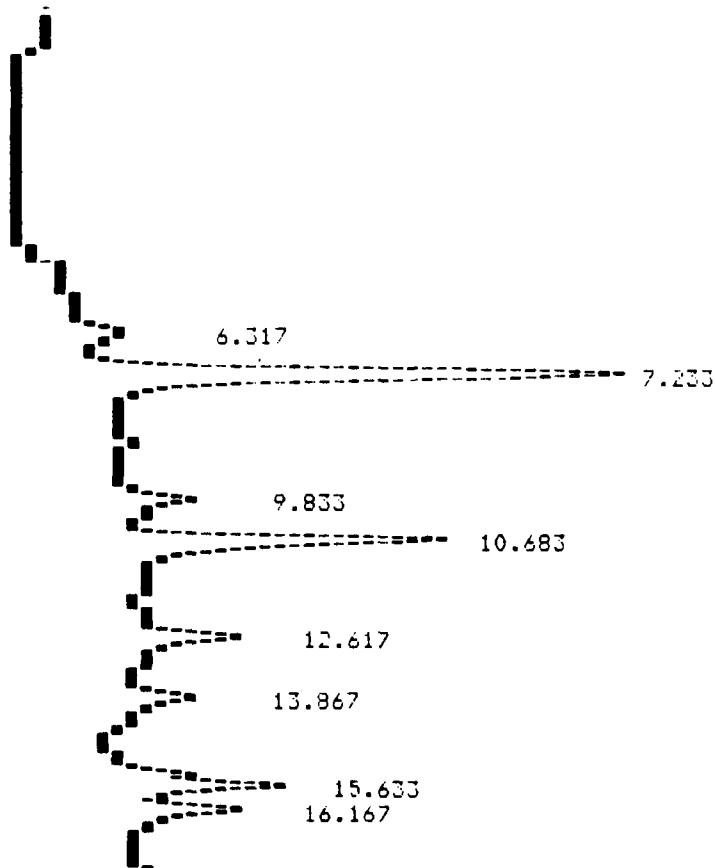
QUALITY ASSURANCE COORDINATOR

CENTRAL FILES _____

OTHER: _____

CHROMATOGRAM PLOT
DATA FILE C:STSD11.PRN
13:19:07 01-30-1991

FULLSCALE MILLIVOLTS 64



Handwritten notes:
10.683
9.833
RT 5.87
Peak 10.683

SKYHARBOR PHOENIX AZ, PROJECT E 409721
DATA FILENAME C:STSD11.PRN
13:19:07 01-30-1991
START OF DAY 11 STANDARD *3ul Low*

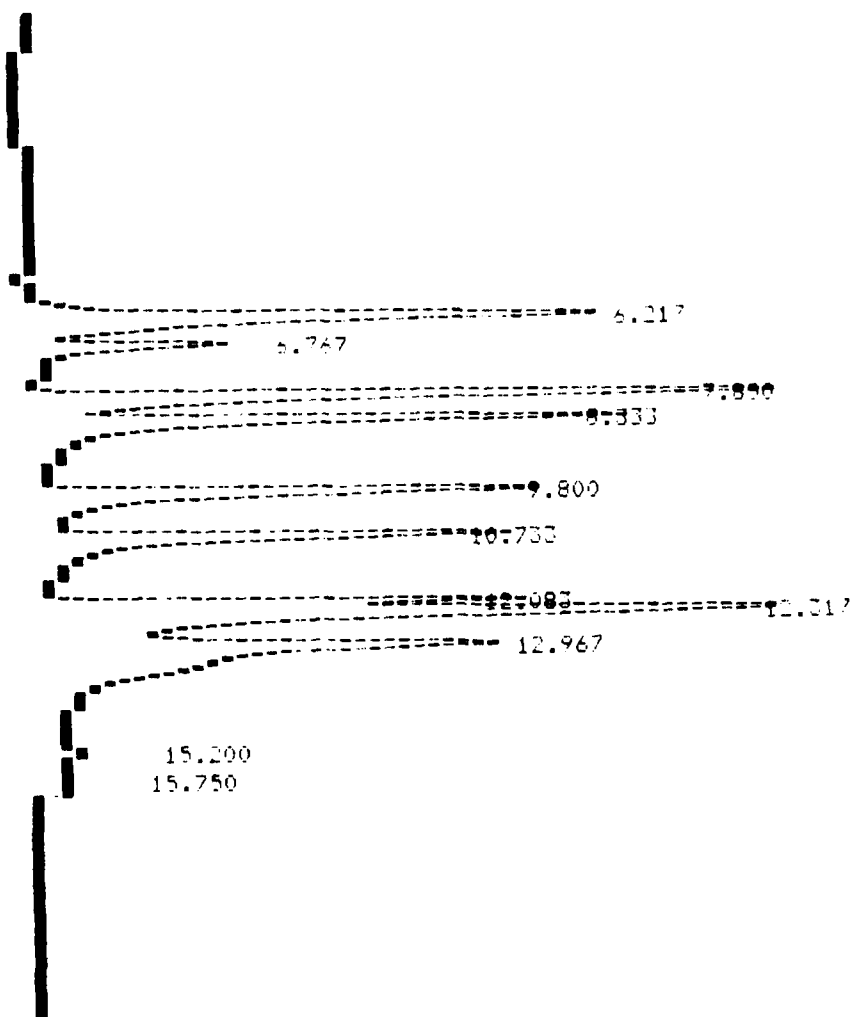
RET.TIME	PEAK AREA	HEIGHT	AREA%	NORM%	EXT.STD	INT.STD.	PEAKNAME	RET
7.233	316.85	53.46	39.8579	37.87	161.95	161.9519	TCASDCE	7.23
9.833	81.76	13.61	3.9892	1.37	5.87	5.8719	BENZENE	9.83
10.683	462.07	38.52	22.5467	16.75	71.64	71.5403	TCE	10.6
12.617	142.23	17.93	6.9401	2.19	9.34	9.3440	TOLUENE	12.6
13.867	117.06	13.56	5.7119	14.71	62.90	62.8953	PCE	13.8
15.633	252.61	22.74	12.3261	5.84	24.98	24.9766	D&MXYL	15.6
16.167	95.20	18.04	4.6941	2.41	10.32	10.3249	PXYL	16.1

DILUTION FACTOR = 1
TOTAL NUMBER OF PEAKS DETECTED 8 AREA REJECT= 50
TOTAL NUMBER OF IDENTIFIED PEAKS 7 USING SKYHARBOR FT 1000
ONLY IDENTIFIED PEAKS WERE REPORTED-OTHER PEAKS MAY HAVE BEEN DETECTED
TOTAL UN-CORRECTED PEAK AREA 2049.394
TOTAL NORMALIZED PEAK AREA 427.6283
INTERNAL STANDARD CORRECTION FACTOR 1
INTERNAL STANDARD PEAK NAME AT TIME 1

TOTAL HYDROCARBONS (total peak area using TPH cal. curve) 2298.797 HAPPEBANK

CHROMATOGRAM PLOT
DATA FILE C:EDSD13.PRN
21:54:33 02-01-1991

FULLSCALE MILLIVOLTS 128



IN
CONTROL
AT BACK - 0.1M
GOOD ANALYSIS

SKYHARBOR PHOENIX AZ, PROJECT E 409721
DATA FILENAME C:EDSD13.PRN
21:54:33 02-01-1991
END OF DAY STD.@ 2uL 100 + 2uL HI BX

RET. TIME	PEAK AREA	HEIGHT	AREA%	NORM%	EXT. STD	INT. STD.	PEAK NAME	EXT.
6.217	1800.21	108.30	15.5782	29.41	874.74	874.7409	TOXICITY	5.12
7.850	1705.73	144.70	14.7312	6.46	198.87	198.8682	BENZENE	1.57
8.333	1381.09	111.70	11.9206	9.90	274.12	274.1245	TCE	5.12
9.800	1192.63	94.80	10.2939	4.82	148.54	148.5386	TOLUENE	5.12
10.733	1192.36	88.50	10.2916	12.70	390.90	390.8995	PCB	5.12
12.083	857.19	94.10	7.3986	5.19	159.66	159.5612	ETHYLENE	1.57
12.317	1655.05	142.70	14.2854	8.30	255.57	255.5690	DDMCL	5.12
12.967	1262.56	88.50	10.8975	7.75	238.56	238.5624	PAH	5.12

DILUTION FACTOR = 1
TOTAL NUMBER OF PEAKS DETECTED 11 AREA REJECT= 50
TOTAL NUMBER OF IDENTIFIED PEAKS 8 USING SKYHARBOR
ONLY IDENTIFIED PEAKS WERE REPORTED-OTHER PEAKS MAY HAVE BEEN DETECTED
TOTAL UN-CORRECTED PEAK AREA 11585.74
TOTAL NORMALIZED PEAK AREA 1078.892
STANDARD CORRECTION FACTOR



INTERNATIONAL
TECHNOLOGY
CORPORATION

NONCONFORMANCE REPORT

PROJECT SKY HARBOR SI

PROJECT NO. 409721

NR NO. 3

PAGE 1 OF 1

DATE: 22 FEB 91

1. NONCONFORMANCE DESCRIPTION

SAMPLES ARE SENT TO THE LABORATORY DAILY AND HELD PENDING PHONED-IN INSTRUCTIONS FOR WHICH SAMPLES TO ANALYZE BASED ON FIELD SCREENING. TWO CASES ARE IDENTIFIED IN WHICH MISCOMMUNICATION HAS RESULTED IN SAMPLES NOT BEING SCHEDULED FOR ANALYSIS. SAMPLES SBI-02-5-7 AND SBI-02-25-27 WERE NOT SCHEDULED FOR ANALYSIS; ONLY 1 SAMPLE FROM THIS BORING WAS ANALYZED. ALSO, SAMPLE SB2-01-50-52 WAS NOT ANALYZED; 2 SAMPLES FROM THIS BORING WERE ANALYZED. THE WORK PLANS CALL FOR THREE SAMPLES TO BE ANALYZED FROM EACH BORING.

SW 3/14/91
LOSS OF THE VOA AND SVOA WILL NOT CAUSE SIGNIFICANT IMPACTS TO THE PROJECT RESULTS. EACH BORING HAS LABORATORY LEVEL C DATA FROM AT LEAST ONE DEPTH. FIELD-LEVEL B ANALYSES WERE CONDUCTED ON ALL SAMPLES AND CAN BE USED AS INDICATORS OF THE PRESENCE OR ABSENCE OF CROSS CONTAMINANTS. ALSO, TPH ANALYSES WILL PROVIDE SOME LEVEL C INDICATIONS OF CONTAMINATION FOR ALL SAMPLES. THE LOSS OF DATA WILL LOWER THE "COMPLETENESS" OBJECTIVE BUT WILL HAVE MINIMAL INTERPRETATIVE SIGNIFICANCE.

IDENTIFIED BY: S. SARGO DATE: 22 FEB 91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

1. SAMPLES FROM SBI-02 HAVE EXCEEDED HOLDING TIME FOR VOA AND SVOA AND DATA CANNOT BE RECOVERED
2. SAMPLES FROM SBI-02 CAN BE SCHEDULED FOR TPH WITHIN HOLDING TIME.
3. SAMPLE SB2-01-50-52 HAVE EXCEEDED HOLDING TIME FOR VOA AND SVOA AND DATA CANNOT BE RECOVERED
4. SAMPLE SB2-01-50-52 TO BE SCHEDULED FOR TPH AND TAL ANALYSIS
5. FUTURE INSTRUCTION FOR SAMPLES TO BE ANALYZED TO BE WRITTEN AND REQUEST FOR ANALYSIS IS FORWARDED TO LAB AND FOLLOWED BY PHONE VERIFICATION

TO BE PERFORMED BY: S. SARGO/LAB #1-4; FIELD SUPER #5

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

[Signature]
Project Manager

2/25/91
Date

[Signature]
Quality Assurance Manager

15 MAR 91
Date

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

5. CORRECTIVE ACTION COMPLETE

PERFORMED BY: [Signature]

DATE: 2-22-91

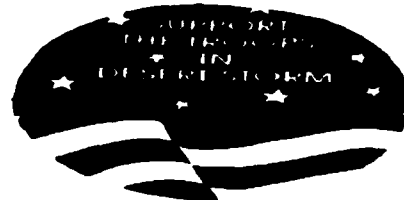
VERIFIED BY: [Signature]

DATE: 3-25-91

CC: PROGRAM MANAGER
PROJECT MANAGER
QUALITY ASSURANCE MANAGER
QUALITY ASSURANCE COORDINATOR
CENTRAL FILES _____
OTHER: _____

TELECOPY REQUEST

TELECOPY NUMBER: IT-44-Longue-Cas, los
TO: Marla Miller
FROM: Steve Savas
DATE: 22 Feb 91
NUMBER OF PAGES: 3 (INCLUDING COVER SHEET)
REMARKS:



IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TN 37923
(615) 690-3211

DISCARD WHEN SENT
PLEASE RETURN

IF ALL PAGES ARE NOT RECEIVED, PLEASE ASK FOR EXTENSION 2223 AT THE ABOVE NUMBER. THANK YOU.

IT KNOXVILLE FAX NO. 615/690-3626 OR
615/690-4652

TRANSMISSION REPORT

THIS DOCUMENT WAS CONFIRMED
(REDUCED SAMPLE ABOVE - SEE DETAILS BELOW)

**** COUNT ****

TOTAL PAGES SCANNED : 3
TOTAL PAGES CONFIRMED : 3

RESULT OF LAST BATCH SENT
*** SEND ***

NO.	REMOTE STATION	START TIME	DURATION	#PAGES	MODE	RESULTS
1	CERRITOS	2-22-91 11:41AM	2 00"	3/ 3		COMPLETED 9600

TOTAL 02:02 00" 3

NOTE:

No. : OPERATION NUMBER 48 : 4800BPS SELECTED EC : ERROR CORRECT G2 : G2 COMMUNICATION
PD : POLLED BY REMOTE SF : STORE & FORWARD RI : RELAY INITIATE RS : RELAY STATION
MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY



INTERNATIONAL
TECHNOLOGY
CORPORATION

RECORD OF

☒ TELECON

☐ MEETING

Project Name

Number

Phase

Task

Subtask

SKY HARBOR

409721

Date

22 FEB 91

Time

1105 EST

CALL FROM ☒ NAME:

CALL TO ☐

Steve Sares

CALL FROM ☐ NAME:

CALL TO ☒

Marla Miller

Telephone Number:

Company Name:

ITAS- CERRITOS

Address:

City

State

Zip Code

Other Participants — Name/Location/Representing:

NONE

Topic

SKY HARBOR ANALYSES.

Summary (Decisions & Specific Actions Required by Named Persons):

1. I've reviewed her fax from 21 FEB with respect to sample nos. and analyses - action items for lab are:

A. Sample no. recorded as SB1-01-0-2-01 - Lab # C1-01-317 01A received 1/30/91 on CofC # 163132 should be SB2-01-0-2-01/-02 SB1-01 was not drilled.

B. Sample SB1-02-5-7-01, Lab # C1-02-071 01A received 2/6/91 should be analyzed for TPH. - Note close holding time.

C. Sample SB1-02-25-27-01, Lab # C1-02-071 02A received 2/6/91 should be analyzed for TPH. - Note close holding time.

D. Sample SB2-01-50-52-01, Lab # C1-01-317 06A received 1/30/91 should be analyzed for TPH and TAC Metals. - Note close holding time on TPH.

Required Action: A. LAB to schedule analyses indicated above

B. Sares to fax phone record for confirmation

C. LAB to include RFA with sample login letter

D. Marla to send copy of tracking spreadsheet regularly.

Prepared by (Signature)

Distribution:

Original to Project File

Copy to Project Manager

Copy to Preparer

☒ Other Distribution (By Preparer)

J. Tybuski, M. Miller

PAGE 1 OF 2



INTERNATIONAL
TECHNOLOGY
CORPORATION

RECORD OF

☒ TELECON
☐ MEETING

Project Name	Number	Phase	Task	Subtask
--------------	--------	-------	------	---------

SKY HARBOR

409721

Date 22 FEB 91

Time 1105 EST

CALL FROM ☒ NAME
CALL TO ☐

Steve Sares

Other Participants — Name/Location/Representing:

CALL FROM ☐ NAME
CALL TO ☒

Marla Miller

Telephone Number:

NONE

Company Name:

ITAS-Ceritos

Address:

Topic

City

SKY HARBOR ANALYSES

State

Zip Code

Summary (Decisions & Specific Actions Required by Named Persons):

2. GROUND water Sampling will be delayed, probably will do ~ 5-6 Soil borings x 3 Samples each in 2 to 3 weeks. Gw Sampling will be after soil borings. Schedule not certain yet. Tybuski will coordinate field schedule as soon as we know more.

3. Lab to send RFA with sample log in receipts
* Tybuski to fax revised RFAs to Lab to indicate changes in analytical program and follow up with usual phone call.

Required Action:

E. Tybuski to fax revised RFA to Lab to indicate changes from original RFA.

Prepared by (Signature)

St Sares

Distribution
Original to Project File
Copy to Project Manager
Copy to Preparer

☒ Other Distribution (By Preparer)

J. Tybuski, M. Miller

PAGE 2 OF 2



R/A Control No. 203062
C/C Control No. 163151

DATE SAMPLES SHIPPED _____

LAB DESTINATION

LABORATORY CONTACT

SEND LAB REPORT TO

IT-Knowing

33333

JOE TYBURSKI

PROJECT CONTACT PHONE NO. 602/275-1325

[illegible]

TURNAROUND TIME REQUIRED:	(Rush must be approved by the Laboratory Project Manager.)	QC LEVEL:	(Levels II and III subject to surcharge, project-specific requirements must be submitted to lab before beginning work.)
/			

Normal <input checked="" type="checkbox"/>	Rush <input type="checkbox"/>	Project Specific <input checked="" type="checkbox"/>
---	--------------------------------------	---

POSSIBLE HAZARD IDENTIFICATION

Non-hazard _____

Flammable _____

Skin Irritant ☒ _____

Highly Toxic _____

Other Solvent acetone

SAMPLE DISPOSAL. (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal.)

Return to Client _____

Disposal by Lab ✓

Archive _____ (Indicate number of months.)

FOR LAB USE ONLY

Received by	Date/Time
1. Mr. A. B. C.	10.10.2010
2. Mr. D. E. F.	10.10.2010
3. Mr. G. H. I.	10.10.2010
4. Mr. J. K. L.	10.10.2010
5. Mr. M. N. O.	10.10.2010
6. Mr. P. Q. R.	10.10.2010
7. Mr. S. T. U.	10.10.2010
8. Mr. V. W. X.	10.10.2010
9. Mr. Y. Z. A.	10.10.2010
10. Mr. B. C. D.	10.10.2010
11. Mr. E. F. G.	10.10.2010
12. Mr. H. I. J.	10.10.2010
13. Mr. K. L. M.	10.10.2010
14. Mr. N. O. P.	10.10.2010
15. Mr. Q. R. S.	10.10.2010
16. Mr. T. U. V.	10.10.2010
17. Mr. W. X. Y.	10.10.2010
18. Mr. Z. A. B.	10.10.2010
19. Mr. C. D. E.	10.10.2010
20. Mr. F. G. H.	10.10.2010
21. Mr. I. J. K.	10.10.2010
22. Mr. L. M. N.	10.10.2010
23. Mr. O. P. Q.	10.10.2010
24. Mr. R. S. T.	10.10.2010
25. Mr. U. V. W.	10.10.2010
26. Mr. X. Y. Z.	10.10.2010
27. Mr. A. B. C.	10.10.2010
28. Mr. D. E. F.	10.10.2010
29. Mr. G. H. I.	10.10.2010
30. Mr. J. K. L.	10.10.2010
31. Mr. M. N. O.	10.10.2010
32. Mr. P. Q. R.	10.10.2010
33. Mr. S. T. U.	10.10.2010
34. Mr. V. W. X.	10.10.2010
35. Mr. Y. Z. A.	10.10.2010
36. Mr. B. C. D.	10.10.2010
37. Mr. E. F. G.	10.10.2010
38. Mr. H. I. J.	10.10.2010
39. Mr. K. L. M.	10.10.2010
40. Mr. N. O. P.	10.10.2010
41. Mr. Q. R. S.	10.10.2010
42. Mr. T. U. V.	10.10.2010
43. Mr. W. X. Y.	10.10.2010
44. Mr. Z. A. B.	10.10.2010
45. Mr. C. D. E.	10.10.2010
46. Mr. F. G. H.	10.10.2010
47. Mr. I. J. K.	10.10.2010
48. Mr. L. M. N.	10.10.2010
49. Mr. O. P. Q.	10.10.2010
50. Mr. R. S. T.	10.10.2010
51. Mr. U. V. W.	10.10.2010
52. Mr. X. Y. Z.	10.10.2010
53. Mr. A. B. C.	10.10.2010
54. Mr. D. E. F.	10.10.2010
55. Mr. G. H. I.	10.10.2010
56. Mr. J. K. L.	10.10.2010
57. Mr. M. N. O.	10.10.2010
58. Mr. P. Q. R.	10.10.2010
59. Mr. S. T. U.	10.10.2010
60. Mr. V. W. X.	10.10.2010
61. Mr. Y. Z. A.	10.10.2010
62. Mr. B. C. D.	10.10.2010
63. Mr. E. F. G.	10.10.2010
64. Mr. H. I. J.	10.10.2010
65. Mr. K. L. M.	10.10.2010
66. Mr. N. O. P.	10.10.2010
67. Mr. Q. R. S.	10.10.2010
68. Mr. T. U. V.	10.10.2010
69. Mr. W. X. Y.	10.10.2010
70. Mr. Z. A. B.	10.10.2010
71. Mr. C. D. E.	10.10.2010
72. Mr. F. G. H.	10.10.2010
73. Mr. I. J. K.	10.10.2010
74. Mr. L. M. N.	10.10.2010
75. Mr. O. P. Q.	10.10.2010
76. Mr. R. S. T.	10.10.2010
77. Mr. U. V. W.	10.10.2010
78. Mr. X. Y. Z.	10.10.2010
79. Mr. A. B. C.	10.10.2010
80. Mr. D. E. F.	10.10.2010
81. Mr. G. H. I.	10.10.2010
82. Mr. J. K. L.	10.10.2010
83. Mr. M. N. O.	10.10.2010
84. Mr. P. Q. R.	10.10.2010
85. Mr. S. T. U.	10.10.2010
86. Mr. V. W. X.	10.10.2010
87. Mr. Y. Z. A.	10.10.2010
88. Mr. B. C. D.	10.10.2010
89. Mr. E. F. G.	10.10.2010
90. Mr. H. I. J.	10.10.2010
91. Mr. K. L. M.	10.10.2010
92. Mr. N. O. P.	10.10.2010
93. Mr. Q. R. S.	10.10.2010
94. Mr. T. U. V.	10.10.2010
95. Mr. W. X. Y.	10.10.2010
96. Mr. Z. A. B.	10.10.2010
97. Mr. C. D. E.	10.10.2010
98. Mr. F. G. H.	10.10.2010
99. Mr. I. J. K.	10.10.2010
100. Mr. L. M. N.	10.10.2010

WHITE - Original to accompany samples
YELLOW - Field copy

9-20-A 811-642



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. **208057**
C/C Control No. **163146**

PROJECT NAME SKY HARBOR ASHG DATE SAMPLES SHIPPED 7 FEBRUARY 91
PROJECT NUMBER 409321.02.06 LAB DESTINATION ITAS - CARROLLS, CA
PROFIT CENTER NUMBER 3521 LABORATORY CONTACT MARIA MUEGA
PROJECT MANAGER DON WILSON SEND LAB REPORT TO IT - KNOXVILLE
BILL TO 312 DIXIE DRIVE, TN
KNOXVILLE, TN
PURCHASE ORDER NO. SEA DON WILSON DATE REPORT REQUIRED 3 WEEKS
PROJECT CONTACT FOR TY BURMAN
PROJECT CONTACT PHONE NO. 602/235-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MIS-01-01-01	SOIL	3 x 6-inch GLASS SLEEVES	Ice to 4°C	TPH, VOA, SVA, TAL, TOP	
MIS-01-01-02	SOIL	2 x 6-inch GLASS SLEEVES	Ice to 4°C	HOLD FOR INSTRUCTIONS	
MIS-01-01-03	SOIL	1 x 6-inch GLASS SLEEVE	Ice to 4°C	TPH, VOA, SVA, TAL, TOP, ULTIMATE NITRATE	IF SAME AMOUNT IS IN SEQUENCE, CONTACT PROJECT CONTACT FOR ORDER OF PRECEDENCE
MIS-01-01-04	WATER	2 x 40 ml	HCL, Ice to 4°C	VOA	
MIS-01-01-05	SOIL	1 x 6-inch GLASS SLEEVE	Ice to 4°C	HOLD FOR INSTRUCTIONS	
MIS-01-01-06	SOIL	LAST LINE	LAST LINE		

TURNAROUND TIME REQUIRED: (Rush must be approved by the Laboratory Project Manager) QC LEVEL: (Levels II and III subject to surcharge; project-specific requirements must be submitted to lab before beginning work)

Normal ☒ Rush ☐ (Subject to rush surcharge) I ☐ II ☐ III ☒ Project Specific ☒

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Non-hazard ☐ Flammable ☒ Skin Irritant ☒ Highly Toxic ☐ Other ☐ (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, archive and disposal)

Return to Client ☐ Disposal by Lab ☒ Archive ☐ (Indicate number of months.)

FOR LAB USE ONLY Received by _____ Date/Time _____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Notified Lab to add sample to analysis group. JRT 2-8-91



REQUEST FOR ANALYSIS

R/A Control No. 208055
C/C Control No. 163141

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409321
PROFIT CENTER NUMBER 3521
PROJECT MANAGER Don Wines
BILL TO IT-Knoxville,
312 Directors Dr.,
Knoxville, TN
PURCHASE ORDER NO SK# Don Wines

DATE SAMPLES SHIPPED _____
LAB DESTINATION _____
LABORATORY CONTACT _____
SEND LAB REPORT TO _____

DATE REPORT REQUIRED
PROJECT CONTACT
PROJECT CONTACT PHONE

PURCHASE ORDER NO.

PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MB2-02-0- 2-01-01-03	Soil	3 x 6-winch Benthos Section w/ 15 min. LWD core	Ice to 4°C	TPH, VOA, SVOA, TAL	
MB2-02-3- 7-01-02	↓	2 x 6-winch Benthos Section	↓	Hold for Instructions	
MB2-02-30- 32-01	↓	1 x 6-winch Benthos Section	↓	Hold for Instructions	
MB2-02-30- 37-01-02	Soil	2 x 6-winch Benthos Section	Ice to 4°C	TAL, VOA, SVOA, TAL	
MB2-02-TB	WATER	2 x 40-L VOA	Ice to 4°C, HCl	VOA	

(Levels II and III subject to surcharge; project-specific requirements must be submitted to lab before beginning work.)

QC LEVEL: _____

_____ (Subject to rush surcharge.)

TURNAROUND TIME REQUIRED: Normal ☒ Rush ☐

(Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Highly Toxic

Skin Irritant

Flammable

(Please indicate disposition of sample following analysis Lab will charge for packing, shipping, archive and disposal)

(Indicate number of months.)

Archive

Disposal by

FOR LAB USE ONLY

Date / Time

Received by

WHITE - Original, to accompany samples
YELLOW - Field copy

126A 10 H's,



REQUEST FOR ANALYSIS

R/A Control No. **B 87028**
C/C Control No. 163111

PROJECT NAME

Sky Harbor ANG

PROJECT NUMBER

409921.02.06

PROJECT MANAGER

Don Winslow

BILL TO

(T-Karoxvix)

312 D.20401D

Koosman, Tal

PURCHASE ORDER NO.

See Deal Window

DATE SAMPLES SHIPPED

LAB DESTINATION

LABORATORY CONTACT

SEND LAB REPORT TO

DATE REPORT REQUIRED

PROJECT CONTACT

PROJECT CONTACT PHONE NO.

[illegible]

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager)

Normal

Rush

(Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard.

Flammable

Skin irritant

Highly Toxic

SAMPLE DISPOSAL

(Please indicate disposition of sample following analysis Lab will charge for packing, shipping, and disposal)

Return to Client

Disposal by Lab

FOR LAB USE ONLY

Received By

Date/Time

WHITE - Original, to accompany samples
YELLOW - Field copy

* S. Series introduced ^{Lab} in early 2000 for TPT



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

R/A Control No. B 87927
C/C Control No. 163141

PROJECT NAME Sky Harbor Ave DATE SAMPLES SHIPPED 4 FEBRUARY 91
PROJECT NUMBER 409221 LAB DESTINATION ITAS - CHARLOTTE
PROJECT MANAGER Don Wilmer LABORATORY CONTACT Charles Ferguson
BILL TO IT - Knoxville SEND LAB REPORT TO IT - Knoxville
312 DIXIE AVE. DR.
KNOXVILLE, TN
PURCHASE ORDER NO. See Don Wilmer DATE REPORT REQUIRED 3 WEEKS
PROJECT CONTACT Tom Tymuski
PROJECT CONTACT PHONE NO. 602/275-1725

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
QC-FB5	WATER	1-LITER GLASS	HCL; 105 ^{ppm}	TPH	
		1-LITER GLASS		SVOA	
		1-LITER GLASS		TOTAL ORGANIC Ph	
		2x 40ml GLASS	HCL;	VOA	
		2x 40ml GLASS	HCL;	Volatil. Carbons	
		1-LITER POLY	HNO ₃ ;	Metals (EXCEPT MERCURY)	
		1-LITER POLY	HNO ₃ ;	MERCURY	
		1-500ml POLY	H ₂ SO ₄ ;	ALUMINUM/NITRATE	
QC-FB5-TB	↓	2x 40ml GLASS	HCL;	VOA	
QC-FB5-TB	WATER	2-40ml GLASS	HCL;	Volatil. Carbons	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)

Normal ☒

Rush

(Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazardous ☒

Flammable

Skin Irritant

Highly Toxic

Other

(Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client

Disposal by Lab ☒

FOR LAB USE ONLY

Received By

Date/Time

WHITE - Original to accompany samples
YELLOW - Field copy



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

PROJECT NAME SKY BLAZER ANAL
PROJECT NUMBER 409321
PROJECT MANAGER BILL WINSTON
BILL TO IT-Knoxville
312 DICKERSON DR
KNOXVILLE, TN
PURCHASE ORDER NO. SEE BILL WINSTON

R/A Control No B 27018
C/C Control No 163132

DATE SAMPLES SHIPPED 29 JANUARY 91
LAB DESTINATION ITAS - CHARLOTTE
LABORATORY CONTACT CHERRY FERGUSON
SEND LAB REPORT TO BILL WINSTON
IT-KNOXVILLE

DATE REPORT REQUIRED 3 WEEKS
PROJECT CONTACT JOE TAYLOR
PROJECT CONTACT PHONE NO. 602/275-1325

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
S17-01-0-2-01-02	SOIL	2 X 6-INCH BEAM SAMPLE	ICE TO 40C	TPH, VOA, SVOA, TAL	
S17-01-0-5-2-01		1 X 6-INCH BEAM SAMPLE		HOLD FOR INSTRUCTIONS	
S17-01-10-12-01				HOLD FOR INSTRUCTIONS	
S17-01-15-13-01				HOLD FOR INSTRUCTIONS	
S17-01-50-17-01				HOLD FOR INSTRUCTIONS	
S17-01-55-18-01		1 X 6-INCH BEAM SAMPLE		TPH, VOA, SVOA, TAL	SEE PROJECT CONTACT IF SAMPLE VOLUME IS INSUFFICIENT
M35-01-0-2-01-02		3 X 6-INCH BEAM SAMPLE		TPH, VOA, SVOA, TAL, TOPB, NITRATE/NITRITE	
M35-01-60-62-01	SOIL	1 X 6-INCH BEAM SAMPLE	ICE TO 40C	TPH, VOA, SVOA, TAL, TOPB, NITRATE/NITRITE	SEE PROJECT CONTACT IF SAMPLE VOLUME IS INSUFFICIENT
M35-01-TB	WASTE (TRIP BURN)	2 X 40 ML	HCL; ICE TO 40C	VOA	

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)

Normal ☒ Rush ☐ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ☐ Flammable ☐ Skin Irritant ☒ Highly Toxic ☐ Possible Permeation ☐ Other ☒ (Please Specify)

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ☐ Disposal by Lab ☒

FOR LAB USE ONLY

Received By Cheryl Ferguson Date/Time 1/30/91

WHITE - Original to accompany samples
YELLOW - Field copy



REQUEST FOR ANALYSIS

Sky Horizon ANG

409721

Bur Wilms

IT-Konzepte

△

IN

Burkholderia

LAB DESTINATION

SEND LAB REPORT TO

PROJECT CONTACT

602/275-1325

8 87017

163131

28 January 91

ITAS-CERITOS

Cheryl Ferguson

Bill Wilson

IT - Karyotyping

THREE WEEKS

Top Trzemeski

602/275-1325

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
MD1-02-0-2-01	↓	6" PRASS SURVE	ICS to 402	TPH, VOA, SVOA	
MD1-02-0-2-02	↓	↓		TPH, VOA, SVOA	
MD1-02-35-33-01	↓	↓		HOLD FOR INSTRUCTIONS	
MD1-02-60-62-01	↓	↓		HOLD FOR INSTRUCTIONS	
MD1-02-75-72-01	SOIL	6" PRASS SURVE		TPH, VOA, SVOA	See Project Contract for Special Instructions
MD1-02-T3	WATER	2 X 40 ML	HCL, ICS to 402	TPH, VOA, SVOA	

Normal ✓

Rush

Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION. (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard

Flammable

Skin Irritant:

Highly Toxic

Other if known (in
(Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis Lab will charge for packing, shipping, and disposal)

Return to Client

Disposal by Lab

FOR LAB USE ONLY

Received By

Date/Time

WHITE - Original, to accompany samples
YELLOW - Field copy

* Cheryl Ferguson, introduced to analyze sample



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

PROJECT NAME SKY HARBOR ANG
PROJECT NUMBER 409771
PROJECT MANAGER DON WILLEN
BILL TO IT CORPORATION
312 KROGER DR
KNOXVILLE, TN 37901
PURCHASE ORDER NO SAC DON WILLEN

DATE SAMPLES SHIPPED
LAB DESTINATION
LABORATORY CONTACT
SEND LAB REPORT TO

1-22-91
CERRITOS, CA
CHEMICAL REAGENTS
DON WILLEN

DATE REPORT REQUIRED 3 WEEKS
PROJECT CONTACT J. TYBURSKI
PROJECT CONTACT PHONE NO 602/275-1325

R/A Control No. 179885
C/C Control No. 1-22-91

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
S81-03-55-51-01	SOIL	6" Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA	
S81-03-55-54-02				↓	
S81-03-55-57-03				TPH, VOA, SVOA	MATRIX SPIN & MATRIPIN
S82-02-0-2-01				TPH, VOA, SVOA, TAL	
S82-02-8-4-01				HOLD FOR INSTRUCTIONS	←
S82-02-10-12-01				HOLD FOR INSTRUCTIONS	←
S82-02-40-41-01				HOLD FOR INSTRUCTIONS	←
S82-02-50-52-01				HOLD FOR INSTRUCTIONS	←
S82-02-55-58-01				HOLD FOR INSTRUCTIONS	←
S82-02-60-62-01	SOIL	6" Brass Sleeve	Ice to 4°C	TPH, VOA, SVOA, TAL	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ☒ Rush ☐ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ☐ Flammable ☒ Skin Irritant ☒ Highly Toxic ☐

Other ☐ (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ☐ Disposal by Lab ☒

FOR LAB USE ONLY

Received By _____ Date/Time _____

WHITE - Original, to accompany samples
YELLOW - Field copy

* Directed Lab (Jones Martin) to analyze 1-23-91



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

PROJECT NAME Sky Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Don Willey
BILL TO ITT Corp
312 Directors Drive
Knoxville, TN
See Don Willey

DATE SAMPLES SHIPPED
LAB DESTINATION
LABORATORY CONTACT
SEND LAB REPORT TO

R/A Control No. B 37010
C/C Control No. 143034
1-21-91
Cerritos, CA
Cheryl Ferguson
Don Willey

PURCHASE ORDER NO.

DATE REPORT REQUIRED
PROJECT CONTACT
PROJECT CONTACT PHONE NO.

2-11-91
J. Tykurstki
602-235-1325

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SBI-03-15- 13-01	SOIL	6" DRAIN SLEEVE	ICE TO 40%	TPH, SO4 VOA, SVOA	Hold For Instructions
SBI-03-20- 21-01					Hold For Instructions
SBI-03-35- 34-01					
SBI-03-35- 34-01	SOIL	6" DRAIN SLEEVE	ICE TO 40%	TPH, VOA, SVOA	
SBI-04-TB	WATER	2 x 40 ml	HCL, ICE TO 40%	VOA	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ☒ Rush ☐ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ☐ Flammable ☐ Skin Irritant ☒ Highly Toxic ☐

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ☐ Disposal by Lab ☒

FOR LAB USE ONLY

Received By _____ Date/Time _____

WHITE - Original to accompany samples
YELLOW - Field copy

* Directed Lab (Lane, Marti) to analyze 1-23-91.

Other See Analysis/Comments
(Please Specify)



INTERNATIONAL
TECHNOLOGY
CORPORATION

REQUEST FOR ANALYSIS

PROJECT NAME SKY HAWK ANGL DATE SAMPLES SHIPPED 1/18/91
PROJECT NUMBER 409721-02.06 LAB DESTINATION ITAS - CERRITOS, CA
PROJECT MANAGER DON WILSON LABORATORY CONTACT CHEMICAL ENGINEERING
BILL TO ITT - KNOXVILLE SEND LAB REPORT TO DON WILSON
312 DUFFORDS RD.
KNOXVILLE, TN 37901
PURCHASE ORDER NO. SEE DON WILSON DATE REPORT REQUIRED STANDARD
PROJECT CONTACT JOE TRUASKI PROJECT CONTACT PHONE NO. 602/295-1325

R/A Control No. 179883
C/C Control No. 105473

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
SD1-05-01/01	SOIL	6 INCH BATHS SIEVE	ICE TO 4°C	TPH, VOA, SVOA	Hold for instructions
SD1-05-01-05/01					Hold for instructions
SD1-05-01-10/01					Hold for instructions
SD1-05-01-15/01					Hold for instructions
SD1-05-01-20/01					Hold for instructions
SD1-05-01-25/01					Hold for instructions
SD1-05-01-30/01					Hold for instructions
SD1-05-01-35/01					Hold for instructions
SD1-05-01-40/01					Hold for instructions
SD1-05-01-45/01					Hold for instructions
SD1-05-01-50/01					Hold for instructions
SD1-05-01-55/01					Hold for instructions
SD1-05-01-60/01					Hold for instructions
SD1-05-01-65/01					Hold for instructions
SD1-05-01-70/01					Hold for instructions
SD1-05-01-75/01					Hold for instructions
SD1-05-01-80/01					Hold for instructions
SD1-05-01-85/01					Hold for instructions
SD1-05-01-90/01					Hold for instructions
SD1-05-01-95/01					Hold for instructions
SD1-05-01-100/01					Hold for instructions
SD1-05-01-105/01					Hold for instructions
SD1-05-01-110/01					Hold for instructions
SD1-05-01-115/01					Hold for instructions
SD1-05-01-120/01					Hold for instructions
SD1-05-01-125/01					Hold for instructions
SD1-05-01-130/01					Hold for instructions
SD1-05-01-135/01					Hold for instructions
SD1-05-01-140/01					Hold for instructions
SD1-05-01-145/01					Hold for instructions
SD1-05-01-150/01					Hold for instructions
SD1-05-01-155/01					Hold for instructions
SD1-05-01-160/01					Hold for instructions
SD1-05-01-165/01					Hold for instructions
SD1-05-01-170/01					Hold for instructions
SD1-05-01-175/01					Hold for instructions
SD1-05-01-180/01					Hold for instructions
SD1-05-01-185/01					Hold for instructions
SD1-05-01-190/01					Hold for instructions
SD1-05-01-195/01					Hold for instructions
SD1-05-01-200/01					Hold for instructions
SD1-05-01-205/01					Hold for instructions
SD1-05-01-210/01					Hold for instructions
SD1-05-01-215/01					Hold for instructions
SD1-05-01-220/01					Hold for instructions
SD1-05-01-225/01					Hold for instructions
SD1-05-01-230/01					Hold for instructions
SD1-05-01-235/01					Hold for instructions
SD1-05-01-240/01					Hold for instructions
SD1-05-01-245/01					Hold for instructions
SD1-05-01-250/01					Hold for instructions
SD1-05-01-255/01					Hold for instructions
SD1-05-01-260/01					Hold for instructions
SD1-05-01-265/01					Hold for instructions
SD1-05-01-270/01					Hold for instructions
SD1-05-01-275/01					Hold for instructions
SD1-05-01-280/01					Hold for instructions
SD1-05-01-285/01					Hold for instructions
SD1-05-01-290/01					Hold for instructions
SD1-05-01-295/01					Hold for instructions
SD1-05-01-300/01					Hold for instructions
SD1-05-01-305/01					Hold for instructions
SD1-05-01-310/01					Hold for instructions
SD1-05-01-315/01					Hold for instructions
SD1-05-01-320/01					Hold for instructions
SD1-05-01-325/01					Hold for instructions
SD1-05-01-330/01					Hold for instructions
SD1-05-01-335/01					Hold for instructions
SD1-05-01-340/01					Hold for instructions
SD1-05-01-345/01					Hold for instructions
SD1-05-01-350/01					Hold for instructions
SD1-05-01-355/01					Hold for instructions
SD1-05-01-360/01					Hold for instructions
SD1-05-01-365/01					Hold for instructions
SD1-05-01-370/01					Hold for instructions
SD1-05-01-375/01					Hold for instructions
SD1-05-01-380/01					Hold for instructions
SD1-05-01-385/01					Hold for instructions
SD1-05-01-390/01					Hold for instructions
SD1-05-01-395/01					Hold for instructions
SD1-05-01-400/01					Hold for instructions
SD1-05-01-405/01					Hold for instructions
SD1-05-01-410/01					Hold for instructions
SD1-05-01-415/01					Hold for instructions
SD1-05-01-420/01					Hold for instructions
SD1-05-01-425/01					Hold for instructions
SD1-05-01-430/01					Hold for instructions
SD1-05-01-435/01					Hold for instructions
SD1-05-01-440/01					Hold for instructions
SD1-05-01-445/01					Hold for instructions
SD1-05-01-450/01					Hold for instructions
SD1-05-01-455/01					Hold for instructions
SD1-05-01-460/01					Hold for instructions
SD1-05-01-465/01					Hold for instructions
SD1-05-01-470/01					Hold for instructions
SD1-05-01-475/01					Hold for instructions
SD1-05-01-480/01					Hold for instructions
SD1-05-01-485/01					Hold for instructions
SD1-05-01-490/01					Hold for instructions
SD1-05-01-495/01					Hold for instructions
SD1-05-01-500/01					Hold for instructions
SD1-05-01-505/01					Hold for instructions
SD1-05-01-510/01					Hold for instructions
SD1-05-01-515/01					Hold for instructions
SD1-05-01-520/01					Hold for instructions
SD1-05-01-525/01					Hold for instructions
SD1-05-01-530/01					Hold for instructions
SD1-05-01-535/01					Hold for instructions
SD1-05-01-540/01					Hold for instructions
SD1-05-01-545/01					Hold for instructions
SD1-05-01-550/01					Hold for instructions
SD1-05-01-555/01					Hold for instructions
SD1-05-01-560/01					Hold for instructions
SD1-05-01-565/01					Hold for instructions
SD1-05-01-570/01					Hold for instructions
SD1-05-01-575/01					Hold for instructions
SD1-05-01-580/01					Hold for instructions
SD1-05-01-585/01					Hold for instructions
SD1-05-01-590/01					Hold for instructions
SD1-05-01-595/01					Hold for instructions
SD1-05-01-600/01					Hold for instructions
SD1-05-01-605/01					Hold for instructions
SD1-05-01-610/01					Hold for instructions
SD1-05-01-615/01					Hold for instructions
SD1-05-01-620/01					Hold for instructions
SD1-05-01-625/01					Hold for instructions
SD1-05-01-630/01					Hold for instructions
SD1-05-01-635/01					Hold for instructions
SD1-05-01-640/01					Hold for instructions
SD1-05-01-645/01					Hold for instructions
SD1-05-01-650/01					Hold for instructions
SD1-05-01-655/01					Hold for instructions
SD1-05-01-660/01					Hold for instructions
SD1-05-01-665/01					Hold for instructions
SD1-05-01-670/01					Hold for instructions
SD1-05-01-675/01					Hold for instructions
SD1-05-01-680/01					Hold for instructions
SD1-05-01-685/01					Hold for instructions
SD1-05-01-690/01					Hold for instructions
SD1-05-01-695/01					Hold for instructions
SD1-05-01-700/01					Hold for instructions
SD1-05-01-705/01					Hold for instructions
SD1-05-01-710/01					Hold for instructions
SD1-05-01-715/01					Hold for instructions
SD1-05-01-720/01					Hold for instructions
SD1-05-01-725/01					Hold for instructions
SD1-05-01-730/01					Hold for instructions
SD1-05-01-735/01					Hold for instructions
SD1-05-01-740/01					Hold for instructions
SD1-05-01-745/01					Hold for instructions
SD1-05-01-750/01					Hold for instructions
SD1-05-01-755/01					Hold for instructions
SD1-05-01-760/01					Hold for instructions
SD1-05-01-765/01					Hold for instructions
SD1-05-01-770/01					Hold for instructions
SD1-05-01-775/01					Hold for instructions
SD1-05-01-780/01					Hold for instructions
SD1-05-01-785/01					Hold for instructions
SD1-05-01-790/01					Hold for instructions
SD1-05-01-795/01					Hold for instructions
SD1-05-01-800/01					Hold for instructions
SD1-05-01-805/01					Hold for instructions
SD1-05-01-810/01					Hold for instructions
SD1-05-01-815/01					Hold for instructions
SD1-05-01-820/01					Hold for instructions
SD1-05-01-825/01					Hold for instructions
SD1-05-01-830/01					Hold for instructions
SD1-05-01-835/01					Hold for instructions
SD1-05-01-840/01					Hold for instructions
SD1-05-01-845/01					Hold for instructions
SD1-05-01-850/01					Hold for instructions
SD1-05-01-855/01					Hold for instructions
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SD1-05-01-865/01					Hold for instructions
SD1-05-01-870/01					Hold for instructions
SD1-05-01-875/01					Hold for instructions
SD1-05-01-880/01					Hold for instructions
SD1-05-01-885/01					Hold for instructions
SD1-05-01-890/01					Hold for instructions
SD1-05-01-895/01					Hold for instructions
SD1-05-01-900/01					Hold for instructions
SD1-05-01-905/01					Hold for instructions
SD1-05-01-910/01					Hold for instructions
SD1-05-01-915/01					Hold for instructions
SD1-05-01-920/01					Hold for instructions
SD1-05-01-925/01					Hold for instructions
SD1-05-01-930/01					Hold for instructions
SD1-05-01-935/01					Hold for instructions
SD1-05-01-940/01					Hold for instructions
SD1-05-01-945/01					Hold for instructions
SD1-05-01-950/01					Hold for instructions
SD1-05-01-955/01					Hold for instructions
SD1-05-01-960/01					Hold for instructions
SD1-05-01-965/01					Hold for instructions
SD1-05-01-970/01					Hold for instructions
SD1-05-01-975/01					Hold for instructions
SD1-05-01-980/01					Hold for instructions
SD1-05-01-985/01					Hold for instructions
SD1-05-01-990/01					Hold for instructions
SD1-05-01-995/01					Hold for instructions
SD1-05-01-1000/01					Hold for instructions

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ☒ Rush ☐ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazardous ☐ Flammable ☐ Skin Irritant ☒ Highly Toxic ☐ Other (Specify) ☐

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ☐ Disposal by Lab ☒

FOR LAB USE ONLY

Received By ☐ Date/Time ☐

WHITE - Original, to accompany samples
YELLOW - Field copy

* Analyze for indicated (i.e., Lab notified 1-21-91 JRT)



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REQUEST FOR ANALYSIS

PROJECT NAME SKY Harbor ANG
PROJECT NUMBER 409721
PROJECT MANAGER Don Willen
BILL TO IT Corp
312 Duncanson Drive
Lawrenceville, GA 30046
PURCHASE ORDER NO. Contract D. Willen
DATE SAMPLES SHIPPED
LAB DESTINATION
LABORATORY CONTACT
SEND LAB REPORT TO
DATE REPORT REQUIRED
PROJECT CONTACT
PROJECT CONTACT PHONE NO. 602-275-1325

R/A Control No. 179880
C/C Control No. 105428
1/18/91
Carroll, CA
Cheryl Ferguson
Don Willen

Sample No	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions
QC-FBI	Water	1-liter amber	NA / 4°C	Organic Lead	
QC-FBI	Water	2-40ml glass	HCL / 4°C	VOA	
QC-FBI		2-40ml glass	HCL / 4°C	Volatile Chloride	
QC-FBI		1-liter amber	4°C	Extractable Organics	
QC-FBI		1-liter poly	HNO ₃ / 4°C	Metals (except Arsenic)	
QC-FBI		1-liter poly	HNO ₃ / 4°C	Mercury	
QC-FBI		1-liter amber	HCL / 4°C	TPH	
QC-FBI		1-40ml glass	HCL / 4°C	BTX, PCN, etc. Data	
QC-FBI		1-500ml poly	H ₂ SO ₄ / 4°C	Nitrate / Nitrite	
QC-FBI-TB		2-40ml glass	HCL / 4°C	Triphenylamine VOA	

TURNAROUND TIME REQUIRED (Rush must be approved by the Project Manager)

Normal ☒

Rush

(Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazardous ☒

Flammable

Skin Irritant

Highly Toxic

Other (Please Specify)

SAMPLE DISPOSAL (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client

Disposal by Lab ☒

FOR LAB USE ONLY

Received By

Date/Time

WHITE - Original, to accompany samples
YELLOW - Field copy

*Cancelled SPT 1-21-91, Lab notified.

Fr.
3-22-91

Weather: Clearing today 50°F cal - in AM. Afternoon
partly cloudy, 65°F, cal -

IT Personnel: M. Gardiner, D. Schamp, B. Wilkins, J. Tyburki

Visitors: MMES - D. Bunn, F. Lebow

Layne: D. Peterson, B. Shrum, W. Williams, M. Phillips

- Arrive at Base at 0630. MMES visitors arrive at
0715. Tailgate Safety Mtg. held w/ IT & MMES.

Contacted Marla Miller (Cerritos) to verify receipt
of samples shipped 3-21-91. Directed Marla to
analyze MBS-04-99-01 for TPH, TORB, VOA, & SVOA.

Drilled and sampled well MW3-01. Sampled well to
70ft, drilled to total depth of 100ft, set
screen and well casing.

Collected three samples of spoils, one each
from well PS-1, PS-2, and PS-3. Samples shipped
on Fed Ex waybill NO. 0144320120.

Collected equipment rinsewater sample no. QC-ER14 from
sampler at well MW3-01. Sample shipped on above
waybill.

Mon
3-25-91

Weather: Overcast 55°F in AM; PM clearing, 75°F

IT Personnel: M. Gardner, B. Wilkins, D. Schamp,
J. Tyburski

Visitors: Layne - D. Peterson, W. Williams, M. Phillips

MMES - D. Bunn

Arrive at Base at ^{JT}070030.

• Contacted Marla Miller (Cerritos) to verify receipt of samples shipped Friday. Instructed Marla to run sample MB3-01-50-51½-01 for VOA, SVOA, TOPb, & TPH.

• Notified Lab to expect large number of samples collected Sat, Sun, & Mon for Tues delivery.

• Completed drilling and sampling soil boring SB3-04 to approx. 74 ft. Completed drilling and sampling SB3-03 to approx. 73 ft.

• Spoke with Steve Sines about various sampling issues at site:

- Third soil boring at site 3 will be last one
- Five poly tanks on site will be sampled for VOC & TPH for disposition of water.
- Piezometer PS-2 will be sampled and analyzed for Site 3 parameters.

Tues
3-26-91

Weather: AM 5-10 mph, intermittent heavy rain;
clearing PM intermittent drizzle 60°F

IT Personnel: M. Gardiner, B. Wilkins, D. Schamp, J. Tybush

Visitors: W. Williams, D. Peterson, M. Phillips, Sugg,
O. Delaughter.

Arrive at Base at 0630.

Verified receipt of large sample shipment with
Marla Miller (IT-Cerritos). Directed Marla to
analyze sample SB3-03-10-11½-01,02 for VOA, SVOA,
TOPh and TPH.

Notified Marla Miller (IT-Cerritos) of error in samples
shipped yesterday. Sample SB3-04-15-16½-01 was
included in shipment but was not noted in RFA or
Chain of Custody. Sample will be analyzed for
VOA, SVOA, TOPh, & TPH. (Reference - Telecom JRT
to Marla Miller 3/26/91).

Developed monitor well MWS-04 by surging,
bailing, and pumping. Purged approx 210 gallons
from well. Well developed strong hydrocarbon odor,
suspect approx 0.01% of PSH in well.

Terminated well development due to weather
conditions; will resume Wednesday.

Depart Base at 1815 for Fed Ex. Boyd &
Gardiner depart Base at 1900.

Thurs
4-4-91

Weather - AM - clear, high clouds 65°F, PM - slight
breeze, 94°F.

IT Personnel - J. Boyd, M. Gardiner, J. Tyburski

- Arrive at Base at 0630. Prep materials and truck for sampling at Site 4 (Papago).
- Arrived at Site 4 at 0830 and set-up at well MW4-01. Well was bailed dry within approx. 1 hr. Returned 5 hrs later and were able to pull an additional $\frac{1}{2}$ gallon. Total volume purged approx. 13 gallons, one well volume for current water level. Will discuss with IT Knoxville as to procedure for sampling this very slow producing well.
- Purged and sampled well MW4-02. This sample and samples identified 43-91 were shipped Fed Ex on waybill no. 0098749770.
- Collected bailer equipment rinseate no. QC-ER20 and shipped on above waybill no.

Notified Kim Laisy - IT - Middlebrook Lab of
samples to expect Friday.

Replaced air compressor. Installed in-line filter to help reduce clogging of pump piston.

Notified by Middlebrook Lab that Friday samples received Saturday were at 10-17°C. Procedure will be changed to use an ice bath in coolers to help chill samples before refrigeration.

Depart site at 1700.

Tues
4-9-91

Weather: AM - Clear, calm 62°F PM - 92°F

IT Personnel: J. Boyd, M. Gardiner, J. Tyburski

Arrive at Base at 0630. Prep equipment for purging by bailer and sampling PS-2. One well volume will be removed from well based on discussion of S. Sares and B. Stanley (Hazwup).

Telecon from S. Sares - Notified that all previous samples (except for samples shipped Mon 4-8) were 6-8°C above specified 4°C. Hazwup has directed all previous wells to be resampled. If samples cannot be chilled adequately they will be held overnight in refrigerator. Measured refrigerator with electronic temp probe, at 4.6°C which is fairly close. Turn refrigerator down slightly.

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NONCONFORMANCE REPORT

NR NO. 4PROJECT AZANG Sky HarborPAGE OF PROJECT NO. 409721DATE: 03/04/91

1. NONCONFORMANCE DESCRIPTION

Problem: No sensitivity of PID detector for TCA, after finding that TCA and DCE are not co-eluding as originally thought.

Criteria: Scope of work required analysis of samples and reporting contamination concentration for TCA.

Impact: Reported concentration for DCE will change along with detection limits; will not be able to report confident TCA values.

IDENTIFIED BY: D. Pray DATE: 02/02/91

2. PROPOSED CORRECTIVE ACTION, INCLUDING INITIATION AND COMPLETION DATES

Continue program on present course, at end of project re-integrate DCE values. review FID response for TCA and see if its possible to determine TCA concentration from FID.

TO BE PERFORMED BY: D. Pray 02/21/91 - 03/04/91

3. APPROVAL FOR PROPOSED CORRECTIVE ACTION

[Signature] 2/21/91
Project Manager Date
[Signature] 2/29/91
Quality Assurance Manager Date

4. CORRECTIVE ACTION TAKEN (IF DIFFERENT FROM THAT PROPOSED)

Same as above. DCE values were reintegrated and corrected values reported, TCA detection limit for FID was high and resulting curve was poor and inconsistent. Results reported with unique qualifier.

5. CORRECTIVE ACTION COMPLETE

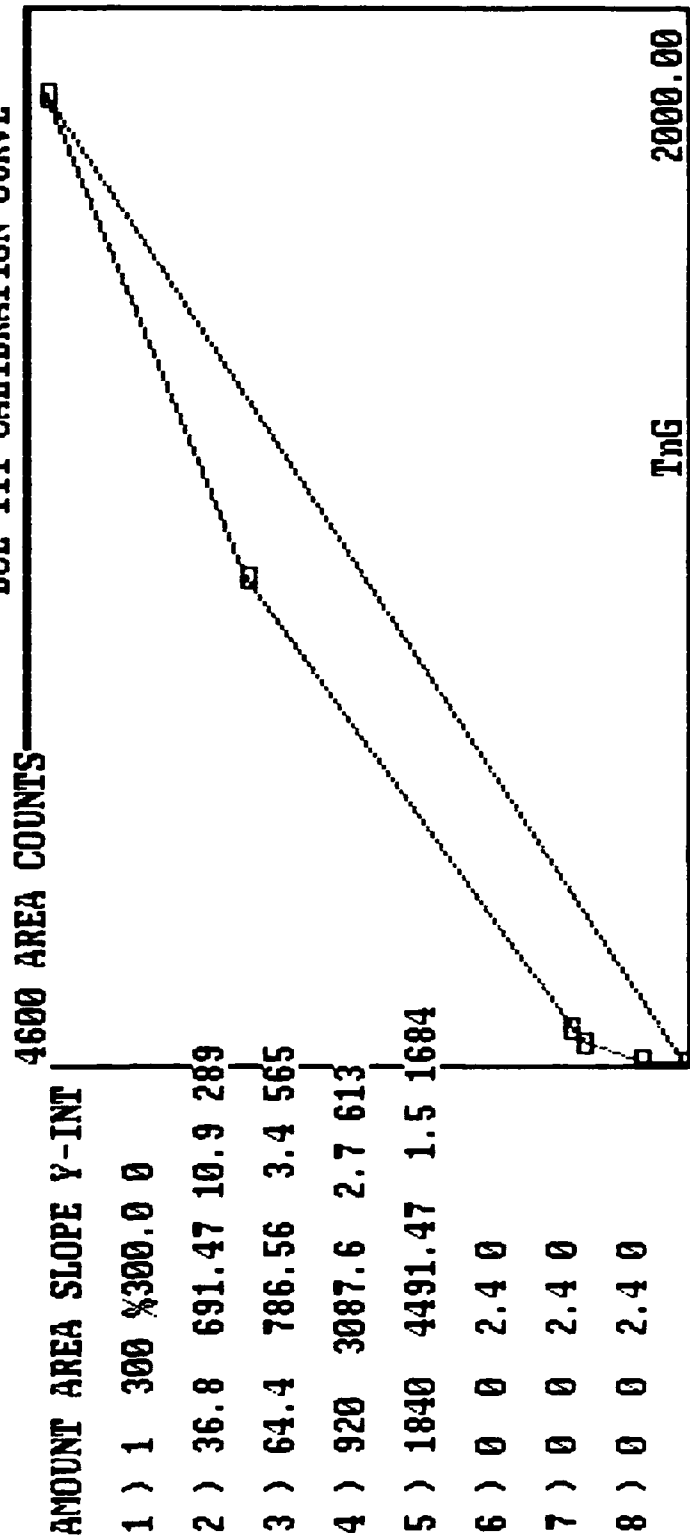
PERFORMED BY: D. Pray DATE: 03/04/91
VERIFIED BY: [Signature] DATE: 3/21/91

CC: PROGRAM MANAGER
PROJECT MANAGER
QUALITY ASSURANCE MANAGER
QUALITY ASSURANCE COORDINATOR
CENTRAL FILES
OTHER:

LOCATION HISTORY FOR PEAK IDENTIFIED AS DCE III
 # CHL.AMT CAL.AREA DUF.AMT DUF.AREA EXP.AMT ACT.AMT DUF

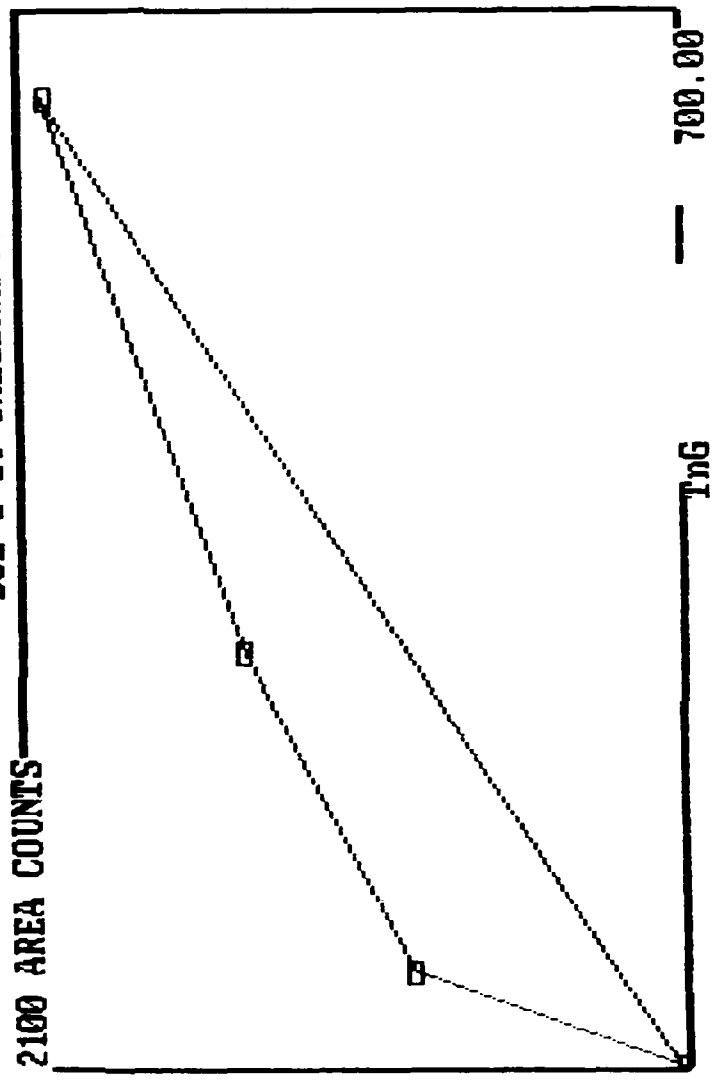
6/3/04/91
 curk only
 DCE

DCE III CALIBRATION CURVE



0.14 $\frac{10^4 \text{ DCE} + 10^4 A}{\text{DCE} + 10^4 A}$

DCE 1-19 CALIBRATION CURVE



1)	64.4	862.79
2)	276	1401.95
3)	644	2037.09
4)	0	0
5)	0	0
6)	0	0
7)	0	0
8)	0	0

APPENDIX B

PRELIMINARY REVIEW OF HYDROGEOLOGIC DATA FOR FACILITIES ADJACENT TO SKY HARBOR AIR NATIONAL GUARD BASE

Memorandum

To Don Willen, Project Manager Date September 18, 1990

From Steve ^{SUB}Sares, Principal Hydrogeologist

Subject Preliminary Review of Hydrogeologic Data for Facilities
Adjacent to Sky Harbor Air National Guard Base

I. INTRODUCTION

In accordance with your request, I have prepared a brief summary of data collection activities and analysis of hydrogeologic data for facilities adjacent to the Sky Harbor Air National Guard facilities at the Phoenix, Arizona Airport (the Base). These activities and preliminary conclusions regarding the hydrogeology of the vicinity are presented below.

The goal of this data collection and review effort is to aid in determining appropriate monitoring-well placement and design specifications for wells to be installed during the Base Site Investigation (SI). As you are aware, there has been much discussion of appropriate depth, screen interval, and location for the SI monitoring wells.

Data collection activities for this task were conducted between July 9 and 11, 1990 and consisted of locating and obtaining available potentiometric records for facilities generally within one and one-half miles of the Base. Field activities such as verification of well locations or measurement of water levels were not conducted during data collection activities. All findings presented below are based on the assumption that data collection, reduction, calculation, and presentation contained in the records are accurate and complete. Records were obtained from the following agencies:

City of Phoenix Environmental Services Department

Arizona Department of Environmental Quality (ADEQ)

Arizona Department of Water Resources (ADWR)

In addition, a Remedial Investigation report was located at a public library which contained hydrogeologic information relevant to the Air National Guard facilities at the Papago Military Reservation (Papago). The sources of information and relevant hydrogeologic information are further discussed below.

II. DATA SOURCE BIBLIOGRAPHY

Six primary sources of information were identified and evaluated in this effort. Selected pages of reports and files were extracted and copied from the sources listed below:

- A. Summary of the Phase II Site Investigation for the City of Phoenix at the West Sky Harbor Fuel Storage Facility and Vicinity, Phoenix Sky Harbor International Airport, Phoenix, Arizona. (May 31, 1990), Groundwater Technology, Inc. Received from Mr. Donn Stoltzfus, City of Phoenix.
- B. ADEQ files for Avis Sky Harbor, ADEQ File No. 4715.122. Received from Mr. Douglas Jamison, ADEQ.
- C. ADEQ files for Garrett General Aviation Services Division, ADEQ File No. 4715.355. Received from Mr. Douglas Jamison, ADEQ.
- D. Draft Remedial Action Plan for Del Rio Landfill, City of Phoenix, Arizona (February 23, 1990), Dames and Moore. Received from Mr. Donn Stoltzfus, City of Phoenix.
- E. Estes Landfill Hydrogeology. Received from Mr. Donn Stoltzfus, City of Phoenix.
- F. Remedial Investigation Report, 52nd Street RI/FS, Phoenix, Arizona for Motorola, Inc. (June 1987), Dames and Moore. Copy at Saguaro Library, Phoenix, Arizona.

In addition to the above referenced documents, several others were reviewed and received from the agencies listed above. Information in the additional documents either duplicated information presented below or are for facilities remote from the Base. Mr. David Annis of the ADWR also provided much valuable discussion regarding facilities and history of hydrogeologic investigations in the area adjacent to the Base.

II. FINDINGS

Results of the hydrogeologic investigation at the Sky Harbor fuel facilities (Reference A) are likely to be directly applicable to the SI as the fuel facilities are located approximately 4,300 feet (0.8 miles) from the center of the Base on a bearing of fifty degrees west of north (N 50 W). These findings are summarized below.

Mr. Don Willen
September 18, 1990
Page 3

Five monitoring wells, 90 feet deep, were installed at the site in March and April 1990. The water level in each well is approximately 71 feet below grade or at an elevation of 1,038 to 1,036 feet above Mean Sea Level (feet MSL).

Detailed casing elevations and depth to water were not included in the information provided, however, a site gradient map indicates a due westerly groundwater flow direction at a gradient of approximately 0.002 or 10.9 ft per mile.

Lithologic logs indicate mixed, unindurated alluvium at the site consisting generally of sand to silt in the 0-5 foot depth interval, sand to pebbles in the 5-15 foot interval, and sand to cobbles below 15 feet.

Avis Car Rental facility at Sky Harbor is conducting an investigation for a fuel release (Reference B). The Avis facility is located approximately 7,600 feet (1.4 miles) from the center of the Base on a bearing of N 82 W. Findings from these files are summarized below.

The depth to water, measured on 24 Nov 87 ranges from 61.26 to 64.51 feet below the surface, this corresponds to an approximate elevation of 1,035 to 1,039 feet MSL.

The groundwater flow direction at the site is generally west with the flow direction diverging to northwest and southwest west of the Avis site. Reports suggest that the divergence may be caused by an Arizona Department of Transportation (ADOT) dewatering project located in line with 21st Street between Buckeye Road and the Salt River.

The ADOT project was in operation at the time the material in the files was prepared (1987). At that time the dewatering system consisted of 11 wells each pumping at approximately 1,500 gallons per minute.

The U.S. Geological Survey (USGS) conducted a pump test during the dewatering project and determined the aquifer transmissivity (T) to be 194,000 GPD/ft, and hydraulic conductivity (K) to be 1,200 GPD/ft, using a saturated thickness of 150 feet.

Mr. Don Willen
September 18, 1990
Page 4

Garrett General Aviation Services Division operates a facility located approximately 6,300 feet (1.2 miles) southwest of the center of the Base on a bearing of S 73 W. This facility is conducting an investigation for fuel and solvent release (Reference C). Findings from the Garrett files are summarized below.

The depth to groundwater was measured to be approximately 55.5 to 57.9 feet below grade or at an elevation of 1,044 to 1,042 feet MSL on 5 Dec 88.

Garrett has presented the groundwater flow direction to be northwesterly (N 36 W). The ADEQ disagrees with this interpretation and states that the ground water flow direction at Garrett is North 80 East. This direction is inconsistent with the regional flow direction as indicated by all other references from the area. I have reviewed the available potentiometric data at Garrett and the flow direction, based on three-point solutions ranges from N 15 W to S 36 E depending on the combination of wells used. Thus the data from Garrett appears inconsistent and should not be relied upon for the Base SI.

The City of Phoenix owns a landfill located approximately 14,600 feet (2.8 miles) southwest of the Base on a bearing of S 74 W. This landfill is called the Del Rio or 16th Street landfill and it is located on the south edge of the Salt River (Reference D). Findings from the files are presented below.

Depth to groundwater is typically 35 to 40 feet below ground level or at an elevation of 1,045 to 1,040 feet MSL.

Water levels in wells have demonstrated fluctuation of up to 28.7 feet in a single well over a period of ten years. The peak water level (all wells) was 1,055.6 feet MSL (approximately 24 feet below ground level). The minimum water level over the same period was 1,020.51 feet MSL (approximately 59.5 feet below ground level).

Hydrographs for monitoring wells over the period from 1979 to 1990 indicate that water elevations in wells in the period 1986 to 1990 are at the lower end of the range (1,025 to 1,045) while during the period 1983 to 1986 they were in peak ranges (1,055 to 1,045). In general, water levels in these wells have declined approximately 20 feet from the 1983 peaks to the 1990 lows or an average of 2.8 feet per year. Prior to the 1983 peak levels, water levels were in the 1,030 foot range as late

Mr. Don Willen
September 18, 1990
Page 5

as 1982. Water levels in monitoring wells demonstrate a strong correlation to flows in the Salt River, thus a continued decline in water levels cannot be projected.

Reference D provided several potentiometric maps for the Del Rio Landfill. These maps were prepared by the authors of the report by unknown means. Based on the maps presented, the groundwater flow direction averages a bearing of N 60 W (300 degrees azimuth) for nine maps presented in the report under dry river conditions. One potentiometric map representing conditions of flow in the river was also presented, the groundwater flow direction in this case was S 57 W (213 degrees azimuth).

The City of Phoenix also owns another landfill southeast of the Base. The Estes Landfill is located approximately 6,500 feet (1.2 miles) from the Base on a bearing of S 82 E (Reference E).

Depth to water at the Estes Landfill is typically 40 to 60 feet below ground level or at an elevation of 1,080 to 1,060 feet MSL.

Water levels in monitoring wells also fluctuate in association with flow in the River at the Estes Landfill. The maximum fluctuation observed in a single well over a period of seven years is 43.77 feet. The peak groundwater elevation in all wells is 1,111.5 feet MSL (approximately 20 feet below ground level). The minimum water level in all wells was 1,038.63 feet MSL (84 feet below ground level).

Potentiometric data from shallow and deep wells suggest a downward vertical gradient at the Estes Landfill, however, lack of well specifications in the information presented prohibits analysis of the vertical gradient conditions.

The groundwater flow direction from prepared maps reviewed averages S 83 W during dry conditions in the river. One map presented for streamflow conditions depicts a groundwater flow direction of S 51 W.

The Motorola facility is located approximately 3000 feet (0.6 miles) on a bearing of S 15 W from ANG facilities at the Papago Military Reservation. Findings from review of Reference F are presented below.

Mr. Don Willen
September 18, 1990
Page 6

Depth to water at the Motorola facility is approximately 22 feet below the ground level or at an elevation of 1,198 feet MSL.

Hydrograph records for well DM101 (nearest to Papago) indicate a maximum fluctuation of five feet, primarily in response to precipitation. The peak water level in this well was 17.5 feet below the top of casing and the minimum measured was 23 feet below the top of casing.

Groundwater flow direction in the shallow portions of the aquifer is approximately S 70 W.

Alluvium overlies volcanic bedrock to a depth of approximately 26 feet. The alluvium thins to the north and west and may be thinner at ANG facilities at Papago.

III. DISCUSSION AND CONCLUSIONS

A. MONITORING WELL SCREEN INTERVAL

Sky Harbor

The Base is located in an area with ground elevation of approximately 1,110 feet MSL. The current monitoring well design calls for 50 feet of screen to be placed 30 feet below the ambient water table and 20 feet above the water table.

Data from the Sky Harbor fuel facility investigation and other sites in the area suggest that the water table will be encountered at a depth of approximately 70 feet below the surface or at an elevation of 1,040 feet MSL. This configuration will require soil borings to be extended to approximately 100 feet below the ground surface for well construction. The well bottom will be located at an elevation of approximately 1,010 feet MSL and the top of the screen interval will be approximately 50 feet below ground or 1,060 feet MSL.

Using data from the Del Rio Landfill (Reference D) during periods of prolonged flow in the Salt River, water levels may be expected to rise as much as 20 to 25 feet. Assuming a 20 foot rise in the water table due to flow in the river, the water table elevation at the Base would be approximately 1,060 feet MSL. This is at the level of the top of screen in proposed monitoring wells. Based on this scenario, it may be prudent to set the top of screen at an elevation of 1,065 or 25 feet above the expected water table.

Mr. Don Willen
September 18, 1990
Page 7

A screen length of 50 feet would place the bottom of the well at 1,015 feet or 25 feet below the expected water table. Assuming five feet of saturated well are required for representative samples to be collected, the water table could go as low as 1,020 feet and the wells would remain useful. This is approximately the lowest level recorded at any of the surrounding areas, the 1,020 level also represents over seven years of useful life at an average water table decline rate of 2.8 feet per year. The 50-foot-long screen proposed should be adequate for the objectives of the SI and future use.

Papago

The current proposed monitoring well design for Papago wells is the same as the wells designed for the Base; thirty feet of screen to be placed within the water table. Given the information presented in Reference F, above, it is likely that upon completion of piezometers at Papago and measurement of water levels, it will be desirable to modify the screened interval to allow 15 feet below and five to ten feet above the water table. This interval should be sufficient to accommodate anticipated water-level fluctuations.

B. MONITORING WELL PLACEMENT

Sky Harbor

Proposed monitoring well locations for the Base SI were developed assuming a westerly (N 90 W) groundwater flow direction. The possibility of significant deviation from this direction motivated the collection of existing data to verify the assumption of westerly groundwater flow.

Because the potentiometric data obtained during this effort were not collected from a single point in time, they cannot be used in preparation of an area potentiometric map, therefore accurate prediction of groundwater flow direction for the base cannot be made.

Generally, published groundwater flow directions are in a westerly (S 83 W) to northwesterly (N 60 W) direction during no-flow conditions in the Salt River. The exceptions to this condition are during flow in the river and one combination of water levels at the Garrett Aviation facility. Groundwater flow direction during river flow is discussed below. The Garrett data are inconsistent, using the same four data points groundwater flow direction variation of

Mr. Don Willen
September 18, 1990
Page 8

140 degrees can be obtained. It is advisable not to utilize this data in placement of SI wells unless separate conformation of easterly flow directions can be made.

The available data indicate that during periods of river flow, the groundwater gradient on the south side of the river is in a southwesterly direction (S 57 W to S 51 W). It follows, assuming flow in the river creates a mound in the water table coincident with the axis of the river, that the groundwater flow direction north of the river would be in a northwest (N 57 W to N 51 W) direction during periods of river flow.

Using the above discussion it is reasonable to assume that groundwater flow direction around the Base is primarily westerly, with a maximum northerly component of 30 degrees north of west during no-flow in the river and a maximum northerly component of 39 degrees during periods of flow in the river. Given this analysis it is recommended that the initial plan of piezometer installation and flow direction determination prior to well placement be adhered to for the SI. It may be prudent to periodically measure water levels in elevation-surveyed wells from surrounding facilities to develop an area potentiometric map during the SI. Any offsite monitoring should be limited to facilities within a one and one-half to two mile radius of the Base.

Papago

Proposed monitoring well locations for Papago were developed assuming a westerly groundwater flow direction. Should piezometric information agree with the data contained in Reference F, indicating a southwesterly flow direction, it may be desirable to relocate well MW4-03 to the west side of Building 112. However this determination should be postponed until site-specific potentiometric data are available.

APPENDIX C
GEOPHYSICAL SURVEY REPORT

GEOPHYSICAL INVESTIGATION

**161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA**

PROJECT NO. 409721

PREPARED BY:

**IT CORPORATION
17461 DERIAN AVENUE, SUITE 190
IRVINE, CALIFORNIA 92714**

SEPTEMBER 1991

Table of Contents

List of Figures	ii
1.0 Introduction	1
2.0 Field Procedures	1
2.1 Geophysical Clearance	2
2.2 Geophysical Survey: Site 5 - Ammunition Disposal Area	2
3.0 Data Processing and Interpretation	3
4.0 Discussion and Results	4
5.0 Conclusions	5
References	R-1
Appendix A - Theoretical Background	
Appendix B - Electromagnetic Induction Profiles	
Appendix C - Sample Ground Penetrating Radar Records	

List of Figures

Figures

Title

- | | |
|---|--------------------------------|
| 1 | Geophysical Survey Area |
| 2 | Geophysical Interpretation Map |

GEOPHYSICAL SURVEY

1.0 Introduction

A geophysical survey was conducted from December 13 to 23, 1990 at Sky Harbor International Airport (IAP) in Phoenix, Arizona. The survey was conducted in two phases. The first phase involved the geophysical clearance of all proposed soil organic vapor (SOV) sampling points and soil boring and monitoring well locations of underground pipelines and utilities at Site 1 (JP-4 Hydrant Area), Site 2 (Hazardous Waste Storage Area), Site 3 (Fuel Bladder Area), Site 4 (107TCS Hazardous Waste Collection Area), and Site 5 (Ammunition Disposal Area). Electromagnetic (EM) utility locators and ground penetrating radar (GPR) methods were used during this phase of the investigation.

During the second phase of the geophysical investigation, EM and GPR surveys were conducted at Site 5 to locate buried ammunition. In 1980, live 50-caliber ammunition was discovered in excavations during installation of a closed circuit television (CCT) system (AZANG, 1990). Ammunition was found in two areas shown in Figure 1. The Preliminary Assessment (PA) reported that ammunition was found at depths ranging from 6 to 8 feet at a location approximately 50 feet south of the CCT trench locations (HMTG, 1988).

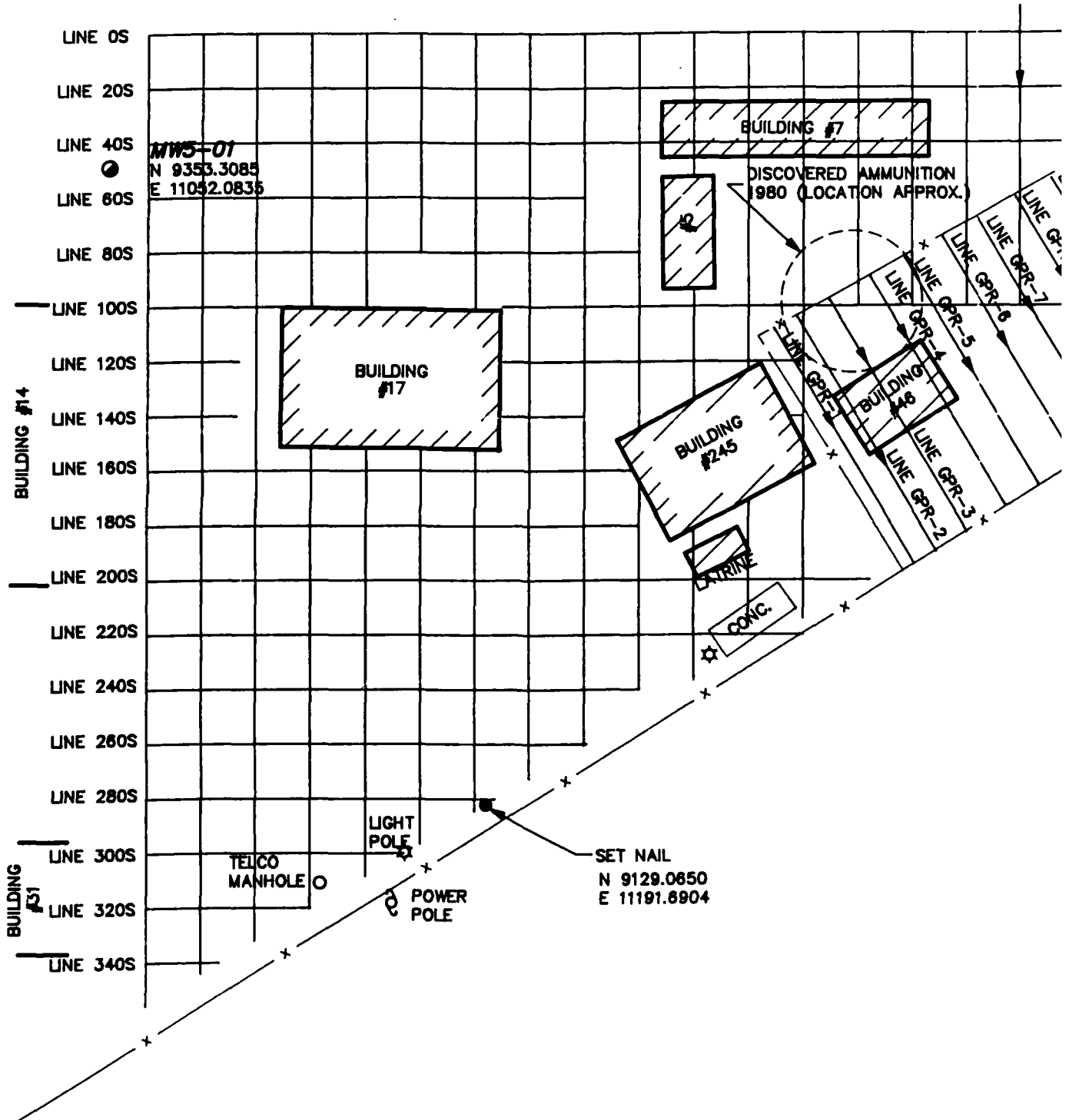
The locations of the Site 5 EM and GPR surveys are shown in Figure 1. Several modifications to the original survey design were necessary based on unanticipated field conditions. As originally planned, magnetic and EM surveys were to be the primary means of locating buried ammunition with the use of GPR restricted to problem areas or areas requiring additional data. However, due to the abundance of surface structures, vehicles, and underground utilities, EM surveying was conducted only in areas relatively uncongested with metallic material. The magnetic survey was not performed because of interference from unwanted sources over much of the area of the site. As a consequence, GPR was used as the primary exploration tool. In addition, the EM survey was extended 130 feet to the west to include a more open area approximating background soil conductivity conditions.

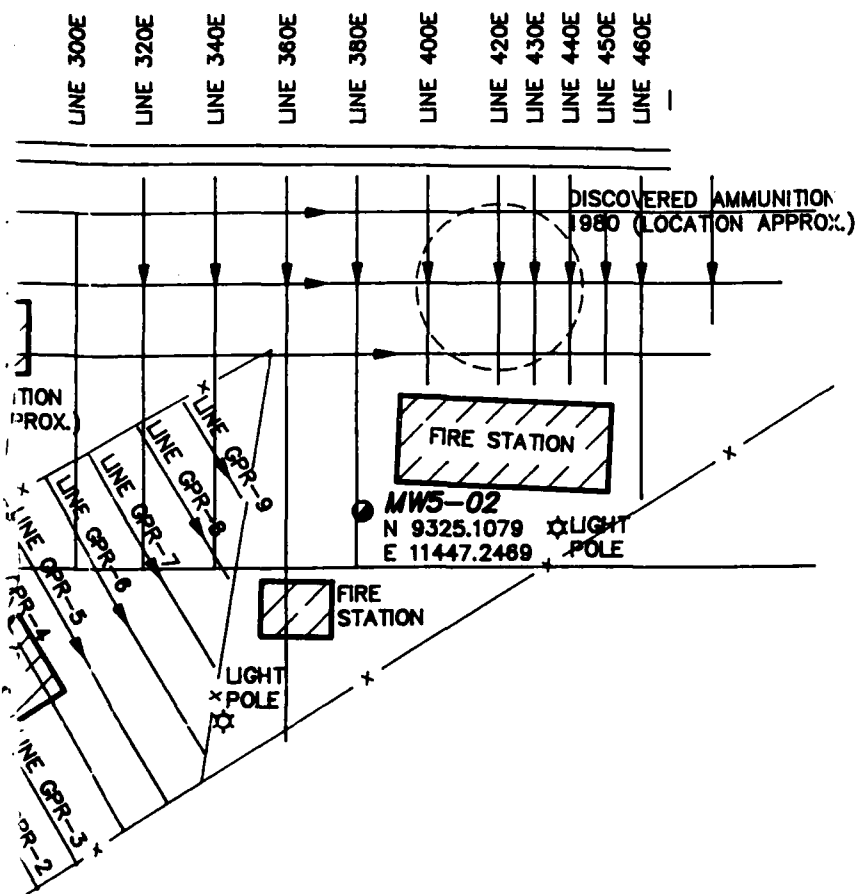
2.0 Field Procedures

This section describes the field procedures used for the geophysical clearance and the

AIRCRAFT PARKING AREA

LINE 0E
LINE 20E
LINE 40E
LINE 60E
LINE 80E
LINE 100E
LINE 120E
LINE 140E
LINE 160E
LINE 180E
LINE 200E
LINE 220E
LINE 240E
LINE 260E
LINE 280E
LINE 300E
LINE 320E





LEGEND:

- ☆ LIGHT
- MANHOLE
- MONITORING WELL
- GPR SURVEY LINE WITH TRAVERSE DIRECTION
- GEONICS EM-31 SURVEY LINE

SCALE:



FIGURE 1

SITE 5—AMMUNITION DISPOSAL AREA GEOPHYSICAL SURVEY AREA

161 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

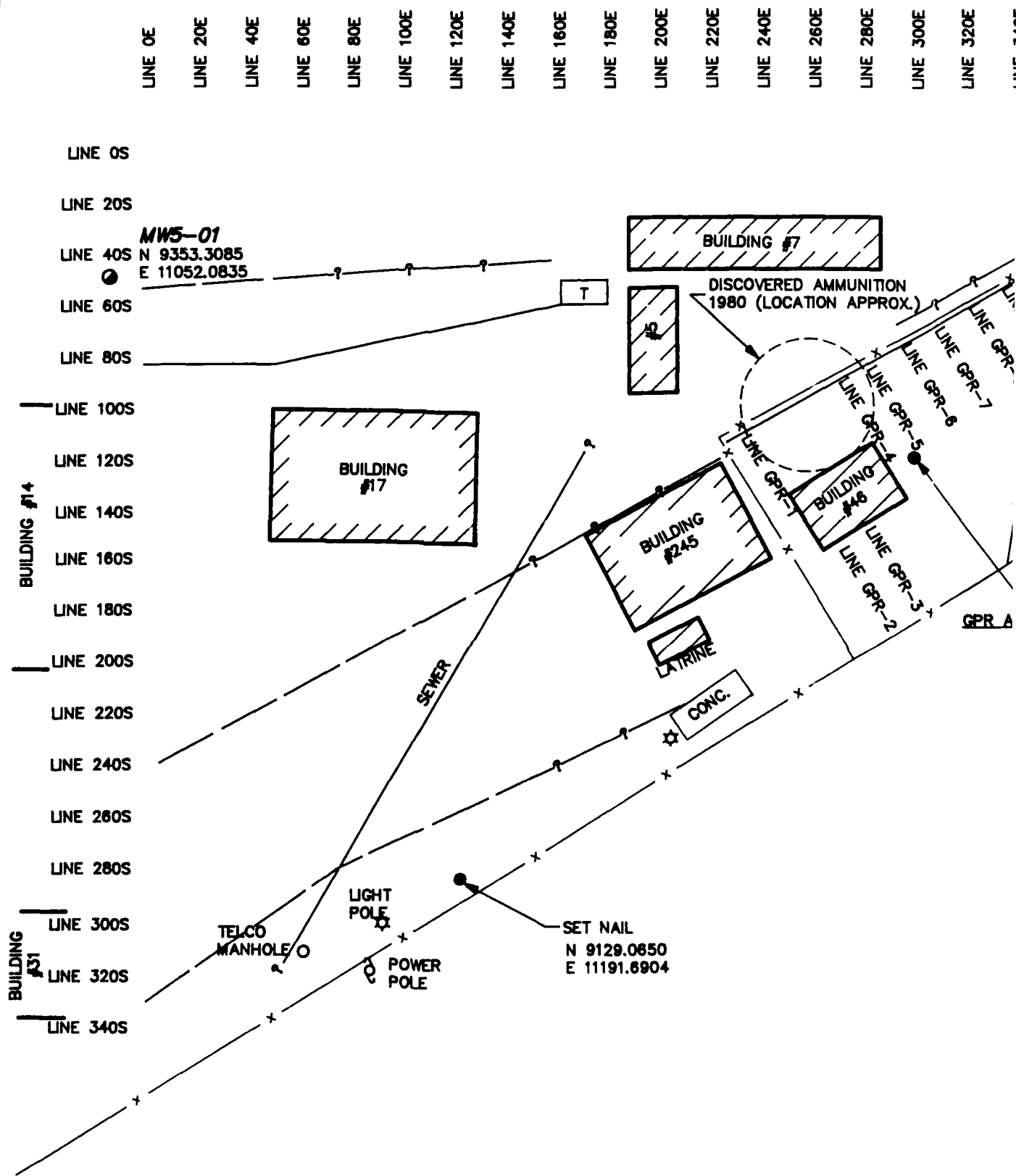
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SI REPORT

DRAWING NO.: H3971B-B-C22
PROJ. NO.: H3971BINITIATOR: S. SARES
PROJ. MGR.: D. WILLENDRAFT. CHK. BY: J. HUBBARD
ENGR. CHK. BY: S. SARESSTARTING DATE: 06/24/91
DATE LAST REV.:
DRAWN BY:

H3971B02 06/17/91 3:32pm SAT

AIRCRAFT PARKING AREA



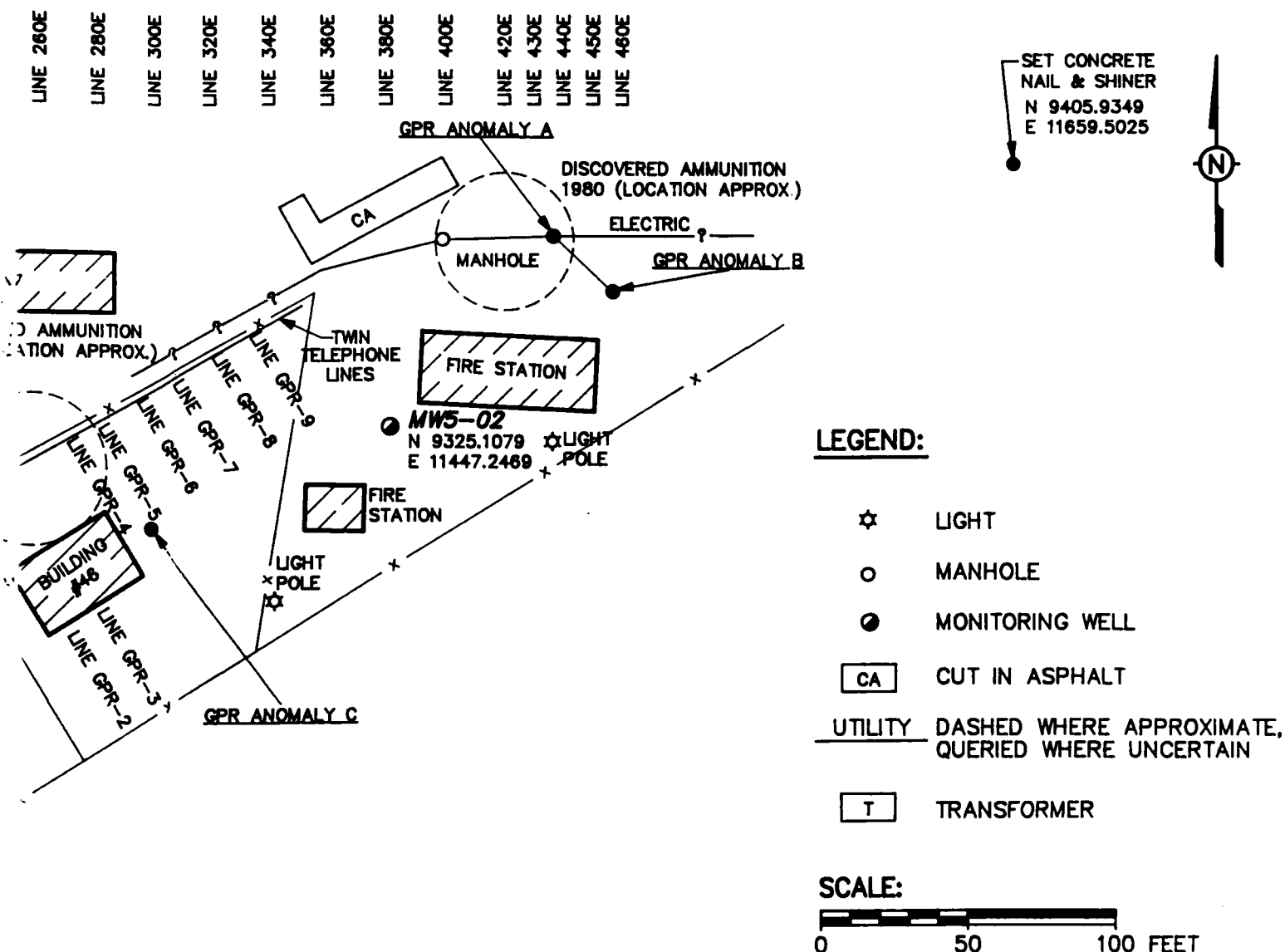


FIGURE 2

**SITE 5—AMMUNITION DISPOSAL AREA
GEOPHYSICAL INTERPRETATION MAP**

151 AREFG, ARIZONA ANG
SKY HARBOR IAP
PHOENIX, ARIZONA

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geophysical survey at Site 5 (Ammunitions Disposal Area). A Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar System 10, which was equipped with 120-, 300-, and 500-MHz monostatic antennae, a Radio Detection Model RD-400 electromagnetic cable locator, and a Metrotech Model 810 pipe and cable detector were used during the geophysical clearance phase. The GPR unit and a Geonics EM-31DL (EM-31) with a digital data logger were used during the geophysical surveys at Site 5. Detailed equipment descriptions and supporting theory are included in Appendix A.

2.1 Geophysical Clearance

Geophysical field procedures used to clear drilling locations of subsurface obstructions are described in this section. First, all utilities near the drilling point evident from utility maps and visual observation were traced by placing the Metrotech or RD-400 transmitter on the line, delineating the line using the receiver, and marking it on the ground surface using orange surveyor's paint. Individual drilling locations were then cleared by holding the transmitter on the line and circling with the receiver at a radius of approximately 40 feet. When a line was located using the receiver, the transmitter was relocated to that point and the line was traced and marked in the vicinity of the drill point. If a utility was found within approximately 3 feet of the drilling location, it was moved and the entire procedure repeated. Finally, in areas where nonmetallic pipes or large numbers of utilities were present, two perpendicular GPR profiles were conducted over the drilling point using the 120-, 300-, and/or 500-MHz antennae. If additional utilities were located within 3 feet of the drilling location, the boring was moved and the clearance procedures repeated.

2.2 Geophysical Survey: Site 5 - Ammunition Disposal Area

EM and GPR surveys were conducted at Site 5 to determine the possible location of buried ammunition disposed of during the 1950s.

To provide spatial control, a 20- by 20-foot grid was marked with surveyors paint in the area of interest. The location of the base grid relative to permanent site features is shown in Figure 1.

Readings of conductivity and in-phase component field strength, as measured by the EM-31, were collected at 5-foot intervals along both north-south and east-west lines spaced 20 feet apart. The locations of the EM survey lines are shown in Figure 1. Data were stored in a digital data logger and downloaded to a laptop computer at the completion of the survey. Many of the EM survey lines were conducted in segments due to buildings and other

obstructions. For example, data were not collected in the Liquid Oxygen Storage Area (Building No. 46 and its perimeter) because of the adverse effects of the oxygen tanks and surrounding fences.

The GPR survey was concentrated in the vicinity of the Ammunition Dump and in the areas where ammunition was discovered during trench excavations in 1980. The locations of the GPR profiles are shown in Figure 1. All GPR profiles within the Liquid Oxygen Storage Area (Lines GPR-1 through GPR-9) were conducted with both the 300- and 120-MHz antennae. All other GPR profiles were conducted with only the 300-MHz antenna. All GPR data were stored on digital tape for later processing.

To allow an accurate interpretation of the geophysical data, the locations of all surface metallic objects were accurately plotted relative to the base grid as shown in Figure 2.

3.0 Data Processing and Interpretation

Computer-generated plots of the EM profiles are included in Appendix B. In-phase and conductivity anomalies were tracked from line to line when possible, or noted as single anomalies. Some portions of the data severely affected by buildings and vehicles were deleted before plotting.

Field mapping of surface metallic objects made it possible to distinguish anomalies caused by known sources from those caused by buried pipelines and other conductive objects. Contour maps of the EM data were not generated because a significant portion of the data was affected by buried objects and surface features.

Color plots of the GPR sections were made for interpretation, with a color scale proportional to the amplitude of the reflected signal. Two-way travel times were converted to depths using an assumed relative dielectric constant of five. Anomalies due to known sources, such as surface objects or buried pipes, are noted on the profiles. Examples of interpreted GPR sections are included in Appendix C.

4.0 Discussion and Results

The first phase of geophysical surveying involving geophysical clearance of subsurface obstructions to drilling resulted in the successful installation of all SOV probes, soil borings, and monitoring wells.

In the second phase of geophysical surveying, EM and GPR were used to assess the likelihood of additional buried ammunition at Site 5. The results of the EM survey are presented graphically in Appendix B and are summarized in Figure 2. After discarding in-phase and conductivity anomalies due to known sources, significant remaining anomalies were observed to exhibit continuity between parallel survey lines, and because of their linear character are interpreted to be caused by underground utilities.

GPR profiles are presented in Appendix C. Assuming a relative dielectric constant of five for geologic materials at Site 5, effective depth of penetration was approximately 5 feet for the 300 MHz antenna and approximately 12 feet for the 120 MHz antenna. Although the penetration depth of the 120 MHz antenna was significantly greater, its resolution was correspondingly lower than the 300 MHz model. In addition, the 120 MHz antenna was not shielded, and therefore was subject to signal interference from aboveground sources. An example of this can be seen in Figure C-4, in which a fence is responsible for a hyperbolic reflection between 75 and 90 feet. Because of these shortcomings, it is not likely that the 120 MHz antenna was capable of resolving containerized ammunition.

The anomalies observed on GPR profiles north of monitoring well MW5-02 were compared with known surface and subsurface features as shown in Figure 2. Two significant anomalies could not be related to known features. Anomaly A, shown in Figures 2 and C-2, is located at approximately 19 feet south on Line 440 east. This anomaly is traceable through several parallel survey lines, and its trace intersects a manhole located at the intersection of Lines 400 east and 20 south. Further, the depth of the anomaly is less than approximately 3 feet. There is little doubt that the source of the anomaly is an underground utility. Anomaly B (Figures 2 and C-2) is characteristic of a metal object very near the ground surface. A similar anomaly was caused by an iron manhole at the intersection of Lines 400 east and 20 south.

GPR surveys in the area north of monitoring well MW5-02 were apparently capable of resolving underground utilities down to several inches in diameter. Therefore, assuming that ammunition was containerized or buried in some other bulk fashion, it is likely its presence would be indicated in the GPR data to a depth of roughly 5 feet. The lack of unaccounted-for GPR anomalies is an indication that large concentrations of ammunition are not present in this location.

GPR profiles in the vicinity of Building 46, labelled GPR-1 through GPR-9 in Figure 1, were compared with known surface and subsurface features. Anomalies traceable across several records can be explained by the presence of features shown in Figure 2. For example, comparison of Figures 2 and C-4 demonstrates the hyperbolic signature of several underground utilities and the masking effect of the concrete-slab floor of Building 46.

No anomalies were found that strongly indicated the presence of buried ammunition near Building 46. However, as shown in Figure C-4, geologic layering below a depth of approximately 2 feet is apparently indistinct to nonexistent. This leads to two possibilities: (1) layering does not exist; this may be a natural condition or layering may be disturbed, (2) layering exists but was not resolved with GPR due to poor penetration or interference from known features. In considering the latter case, Figures C-1, C-2, and C-3 should be compared to Figure C-4. Figures C-1, C-2, and C-3 are radar profiles obtained along survey lines located approximately 150 feet northeast of Building 46 (Figure 1). Geologic layering in this area appears much more distinct than in the vicinity of Building 46; thereby lending support to the former possibility.

5.0 Conclusions

Two phases of geophysical surveying were conducted at Sky Harbor IAP using GPR and EM methods. The first phase of surveying involved geophysical clearance of drilling and SOV locations of subsurface obstructions. In the second phase of the survey, subsurface conditions were assessed for the presence of buried ammunition.

The geophysical clearance phase of work resulted in the successful installation of all borings, monitoring wells, and SOV sample points.

The results and conclusions of the second phase of the investigation are based primarily on GPR data. The EM data were of limited use because of the adverse effects of abundant

surface and subsurface electrically conducting material not related to previous disposal operations.

Radar data in the vicinity of Building 46, the Liquid Oxygen Storage Area, did not provide direct evidence of buried ammunition. However, the apparent lack of layering in geologic materials within this area may be due to excavation and disruption during disposal operations.

Geologic layering appears more distinct in the survey area northwest of Building 46. This may be an indication that disposal has not occurred in this area. Further, no anomalous materials were apparent in the radar data to its approximately 5-foot depth limit, although underground utilities were clearly resolved in this same interval. This implies that buried ammunition, if present and of approximately the dimensions of a typical underground utility diameter, would be detected to a depth of approximately 5 feet.

Direct confirmation of the presence or absence of buried ammunition at Site 5 is not possible based solely on nonintrusive methods. Individual cartridges smaller than the minimum dimensions resolved by GPR may be present at any of the locations surveyed. Ammunition in any form may be present at depths greater than effectively sensed by radar. Finally, ammunition disposal occurring in discrete zones of dimensions smaller than the geophysical grid spacing of 20 feet may not have been crossed by a geophysical survey line and therefore could remain undetected.

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APPENDIX A
THEORETICAL BACKGROUND

APPENDIX A

THEORETICAL BACKGROUND

A.1.0 Electromagnetic Induction

Electromagnetic (EM) induction equipment used during this investigation consisted of a Geonics EM-31DL terrain conductivity meter (EM-31) with an Omni digital data logger, a Metrotech Model 810 pipe and cable detector (Metrotech), and a Radio Detection Model RD-400 electromagnetic cable locator (RD-400).

The EM-31 has a transmitter and receiver coil mounted at each end of a 12-foot-long plastic boom. An audio-frequency alternating current is applied to the transmitter coil, causing the coil to radiate a primary EM field with a magnetic field vector parallel to the axis of the coils. This time varying magnetic field induces eddy currents in any conducting material in the subsurface as described by Faraday's Law on induction. These eddy currents have an associated (secondary) magnetic field with a strength and phase shift relative to the primary field that is dependent on the conductivity of the medium. The receiver coil measures the resultant effect of both primary and secondary fields. By comparing the signal at the receiver to that at the transmitter, the instrument is able to record the in-phase component (in-phase) and the component 90 degrees out of phase (quadrature) with the primary field.

Most geological materials are poor conductors, and the flow of current through the material takes place in the pore fluids (Keller and Frischknecht, 1966). Conductivity is predominantly a function of soil type, porosity, permeability, pore fluid ion content, and degree of saturation. The EM-31 is calibrated so that the out-of-phase component is converted to electrical conductivity in units of millisiemens per meter (mS/m) (McNeill, 1980). The in-phase component is read in parts per thousand (ppt) of the primary EM field and is generally adjusted in the field to read zero response over background materials.

The depth of penetration for EM induction instruments is dependent on the transmitter-receiver separation and coil orientation (McNeill, 1980). The EM-31 has an effective exploration depth of about 18 feet when operating in the vertical dipole mode (horizontal coils). In the absence of large metallic features such as tanks, drums, pipes, and reinforced concrete, the maximum instrument response results from materials at about 3 to 5 feet below ground surface. A single buried drum typically can be located to depths of about 5 feet whereas clusters of drums can be located to significantly greater depths depending on

background noise. The EM-31 generally must pass over or very near to a buried metallic object to detect it. Both the out-of-phase (conductivity) and in-phase components exhibit a characteristic anomaly over near-surface metallic conductors. This anomaly consists of a narrow zone having strong negative amplitude centered over the target and a broader lobe of weaker, positive amplitude on either side of the target. For long, linear conductors such as pipelines, the characteristic anomaly is as described above when the axis of the coils (instrument boom) is at an angle to the conductor; however, when the instrument boom is oriented parallel to the conductor, a positive amplitude anomaly is obtained.

EM-31 applications include the delineation of soil contamination, oil brine pits, buried metallic and nonmetallic debris, landfill boundaries, buried pipes and cables, and buried drums and tanks.

The RD-400 and Metrotech are specifically designed to accurately locate and delineate underground pipes and utilities. A transmitter emits a radio-frequency signal that induces a secondary EM field in nearby utilities. A receiver unit measures the signal strength of this secondary field and emits an audible response to allow the precise location of the pipe, cable, or other conductor in which a signal is induced. If the utility is accessible anywhere, the source signal can be directly applied to it, making the secondary field much larger and readily measurable.

A.2.0 Ground Penetrating Radar

Ground penetrating radar (GPR) equipment used during this investigation consisted of a Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar System 10 equipped with 120-MHz, 300-MHz, and 500-MHz monostatic antennae.

In conducting a GPR survey, a transmitter antenna that emits a high frequency (center frequencies in the range of 80 to 900 MHz) EM wave into the subsurface is pulled along the survey line. This wave propagates at the speed of light in a vacuum scaled by the square root of the relative dielectric constant of the medium and reflects at boundaries where the relative dielectric constant (and therefore the propagation velocity) changes. The contrast in velocity between the two media can be quantified as a reflection coefficient at the boundary. The magnitude of the reflection coefficient increases as the contrast in velocities increases, and its sign is positive or negative depending on whether the velocity increases or decreases, respectively, at the boundary.

The reflected signal is detected at a receiver antenna, often as a characteristic triplet that is the result of the receiving antenna response and multiples generated along the propagation path. The signal is transmitted to a control unit, displayed on a color monitor, and saved on digital tape (if necessary).

As predicted by Maxwell's equations for a propagating EM wave, two kinds of charge flow are caused by the alternating electric (E) and magnetic (H) fields associated with it (Ulriksen, 1982). These are conduction currents and displacement currents. The conduction current term is predominant at lower frequencies and it is these that are used in the EM induction method. At the higher frequencies used in the GPR method, the displacement current term becomes predominant. The high frequencies will set bound charges in motion causing polarization.

The material physical properties that describe the movement of charges by conduction currents and displacement currents are the conductivity and the dielectric constant of the medium, respectively. The conductivity is a measure of the ease with which charges and charged particles move freely through the medium when subjected to an external electric field. The dielectric constant, or its value normalized by the dielectric constant of free space, called the relative dielectric constant, is a measure of how easily a medium polarizes to accommodate the EM fields of propagating wave (Keller and Frischknecht, 1966).

Although conductivity has a lesser effect on the transmission of EM waves emitted from a GPR unit, it does have an important effect on the attenuation of the waves (Ulriksen, 1982). Highly conductive media will attenuate the EM signal rapidly, restricting depth penetration of the first several feet. Highly resistive (poorly conductive) media will allow much deeper depth of penetration. The frequency of the transmitted waves also affects the depth of penetration. Lower frequencies penetrate deeper, but have low resolution, whereas the higher frequencies can resolve smaller objects and layers at the expense of decreased effective depth penetration.

In unconsolidated materials, conduction takes place mostly through the pore fluids (Keller and Frischknecht, 1966). Changes in pore fluid content, porosity, permeability, and degree of saturation will therefore affect reflected and refracted EM signals. This is how trenches, in which there may be different compaction relative to the surrounding area, can be identified. When the target of a GPR survey is a metallic conductor such as metal pipes and cables, drums, tanks, ammunition shells, etc., the mechanism is somewhat different. An EM wave

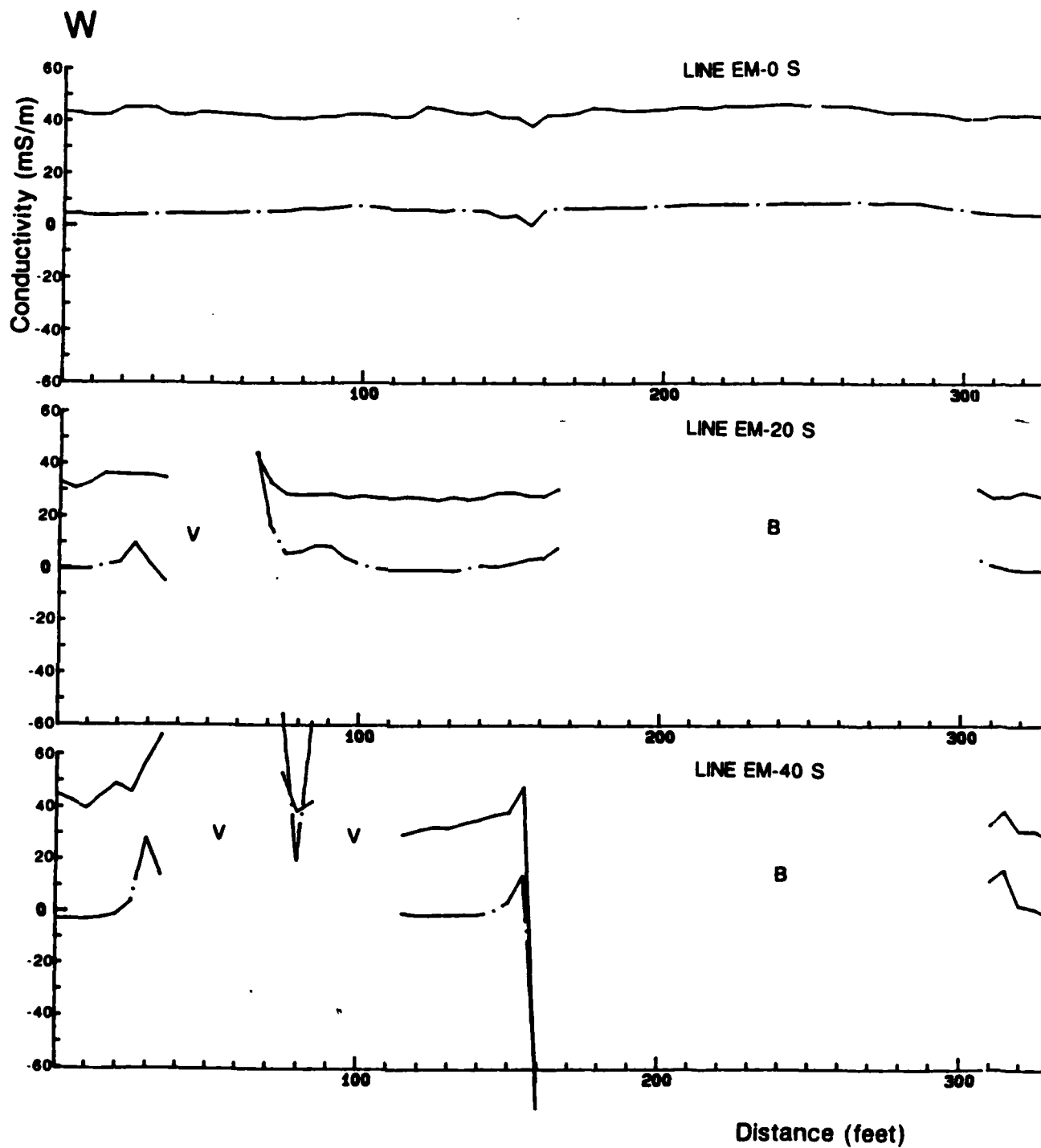
will completely reflect when reaching a metallic conductor. This total reflection makes metallic targets well suited for the GPR method when they are within the depth of penetration range of the instrument. There will be no reflections from below the metallic conductor, although there generally will be multiples. The edges of the metallic reflector will have diffraction patterns that are a result of the fact that both the transmitting and the receiving antennae are not focused, but emit and receive from a 45 degree cone. This cone allows the radar to see objects that are ahead of it, placing them deeper in time. As the radar approaches the object, the reflection becomes shallower, with the shallowest reflection taking place when the radar is right above it. The same pattern will be seen as the antenna moves away from the object.

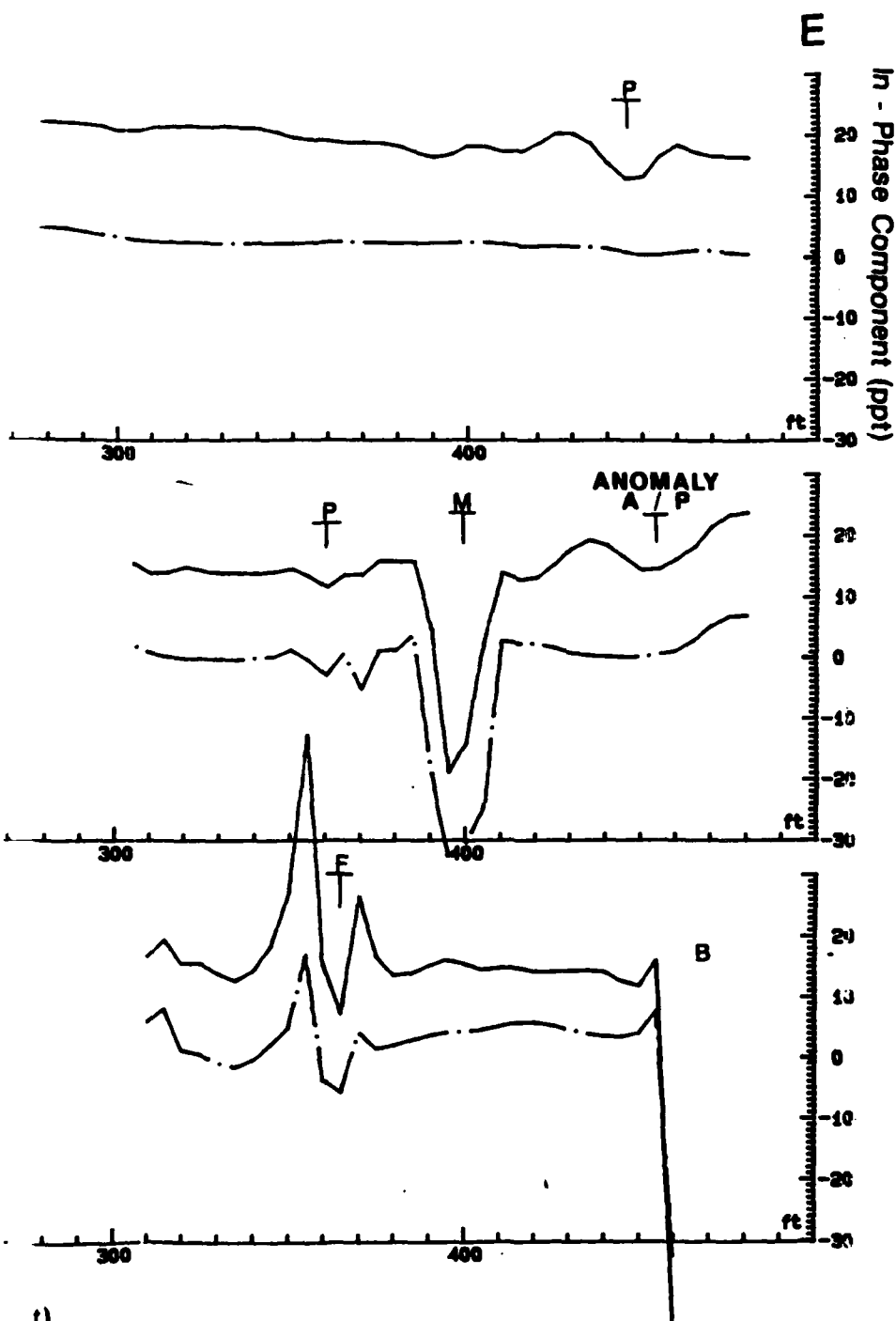
Applications of GPR include delineation of pits and trenches containing metallic and nonmetallic debris; location of buried pipes, drums, and tanks; mapping of landfill boundaries; and mapping of near-surface geology. Near-surface metallic objects such as pipes and tanks exhibit a characteristic high-amplitude hyperbolic anomaly and generally are relatively easy to recognize.

APPENDIX B

ELECTROMAGNETIC INDUCTION PROFILES

DRAWN BY	J. WALL	CHECKED BY	L.C.	4/30/91	DRAWING NUMBER	409721-B13





LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 - - - IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-1

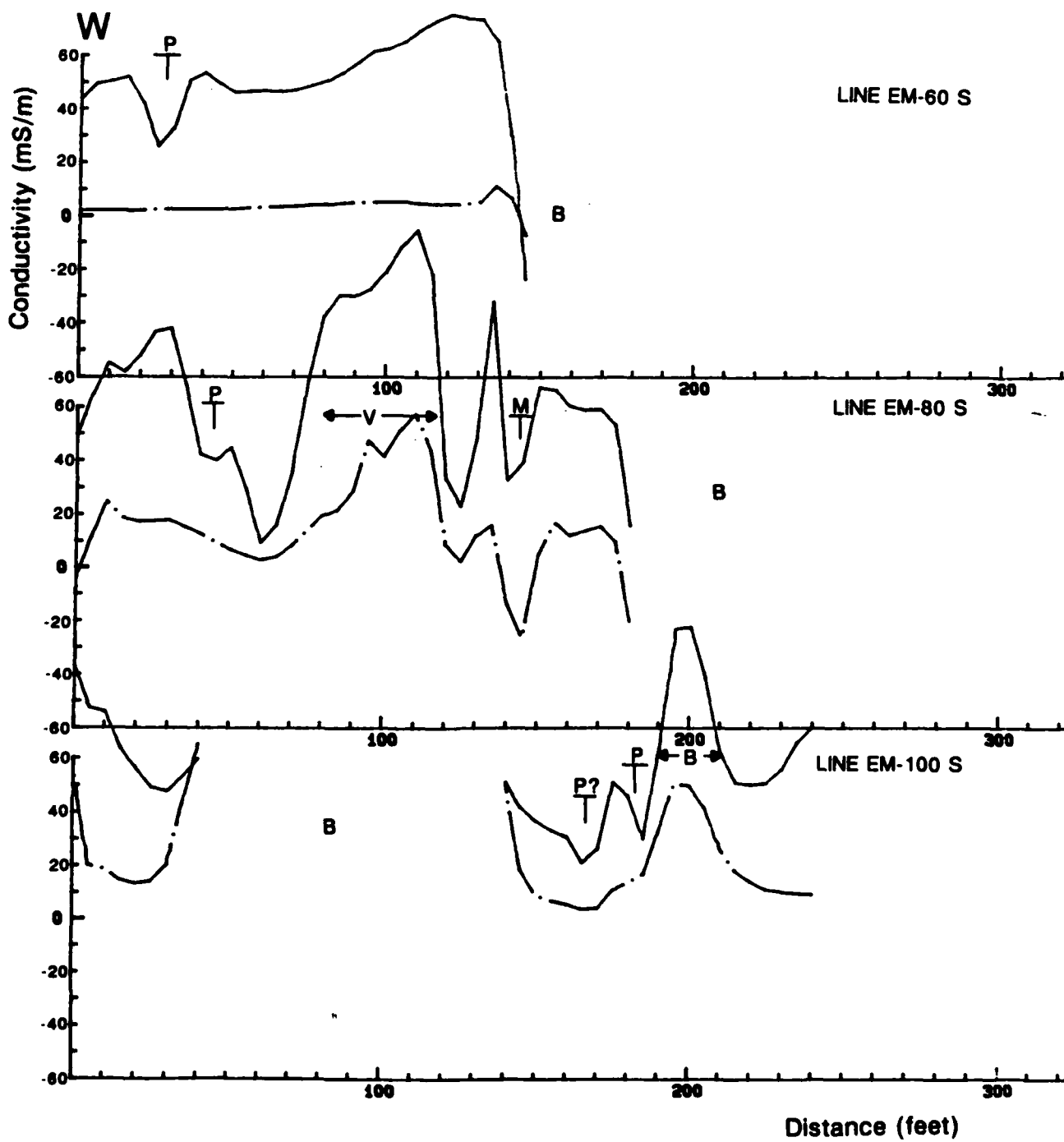
ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
 161 AREFG

SKY HARBOR IAP
 PHOENIX, ARIZONA



DRAWN BY J. WALL
 CHECKED BY L.C.
 APPROVED BY L.C.
 DRAWING NUMBER 409721-B14
 4/30/91
 4/30/91



0 S

0 S

0 S

et)

In - Phase Component (ppt)

LEGEND:

B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

— CONDUCTIVITY -
MILLISIEMENS/METER (mS/m)
- - - IN-PHASE COMPONENT -
PARTS PER THOUSAND OF PRIMARY
ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-2

ELECTROMAGNETIC INDUCTION PROFILES

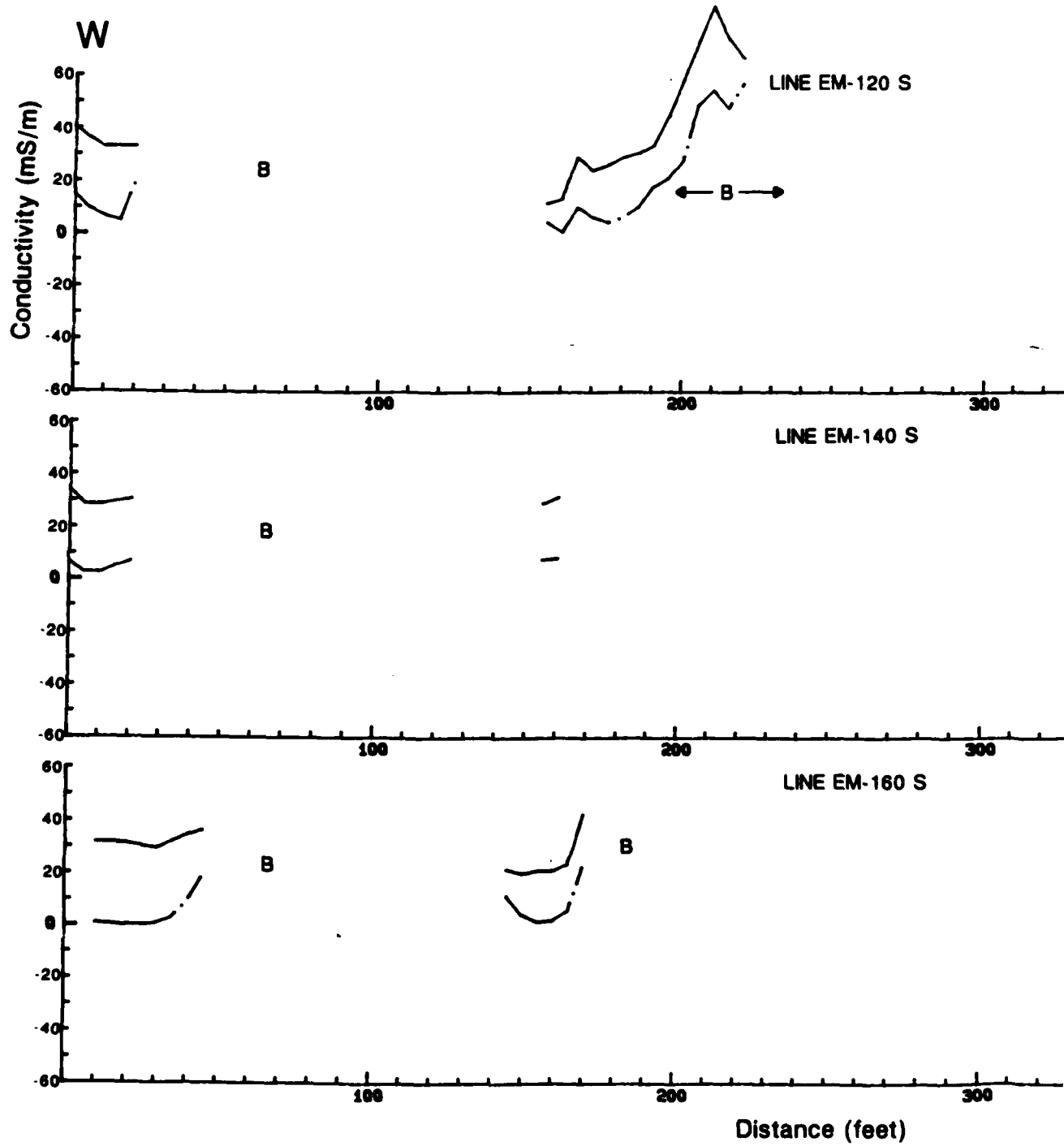
SITE 5 - AMMUNITION DISPOSAL AREA
181 AREFG

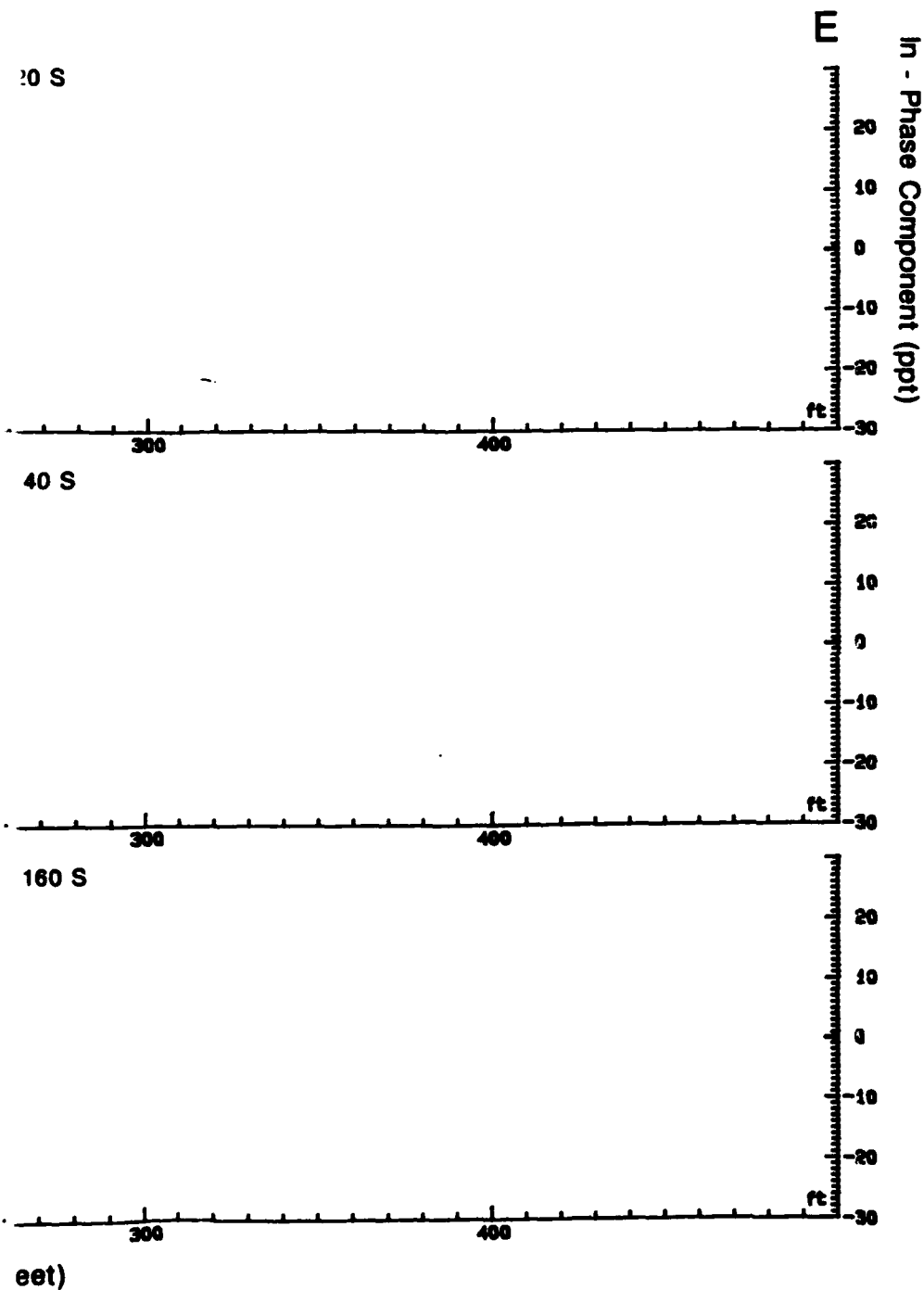
SKY HARBOR IAP
PHOENIX, ARIZONA



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DRAWN BY	J. WALL	CHECKED BY	L.C.	4/30/97	DRAWING NUMBER	409721-B17
				4/30/97		
BY	4-24-97	APPROVED BY	02/2/97			





LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 — IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-3
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
 181 AREFG
 SKY HARBOR IAP
 PHOENIX, ARIZONA

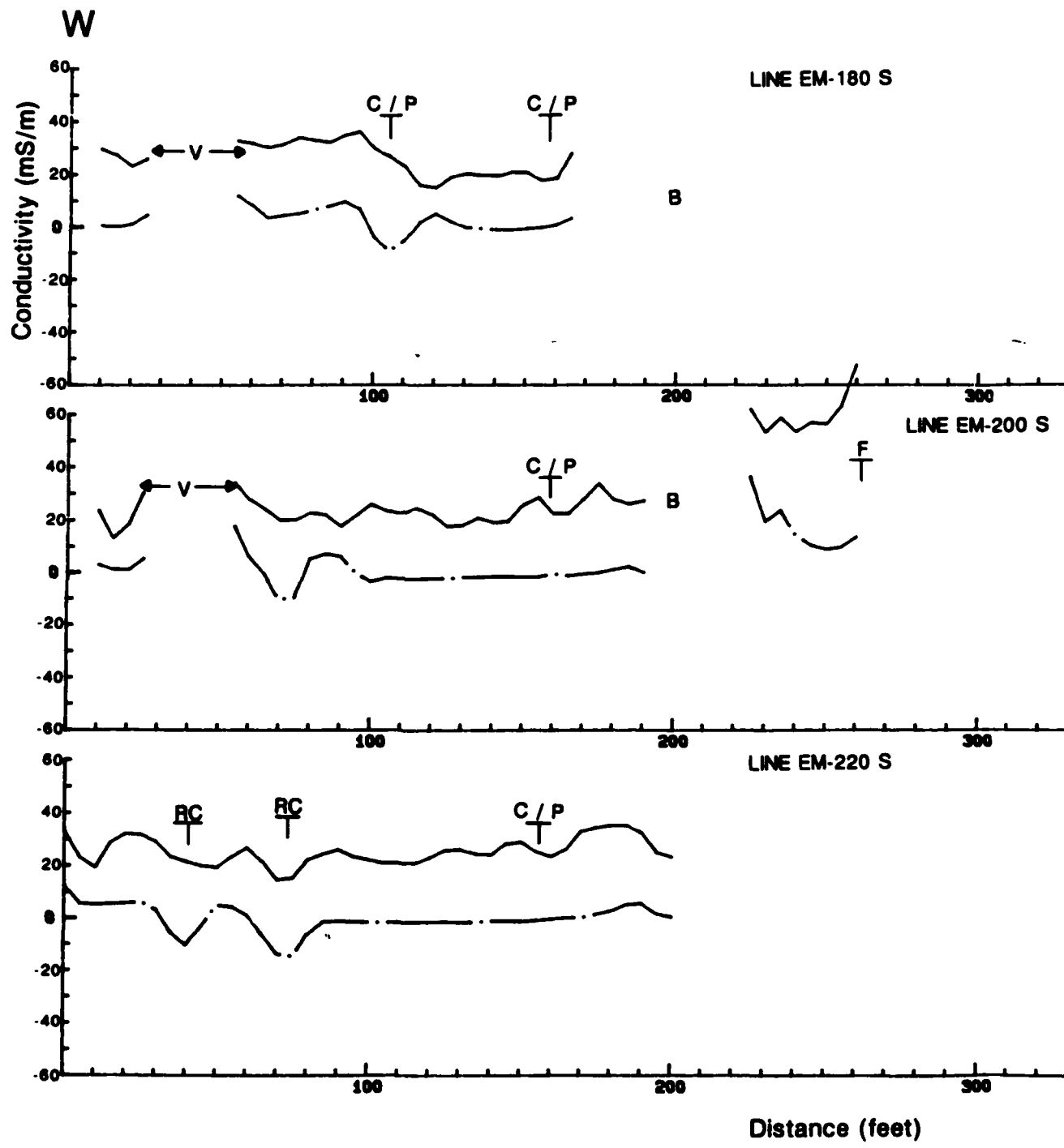
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DRAWING NUMBER 409721-B15

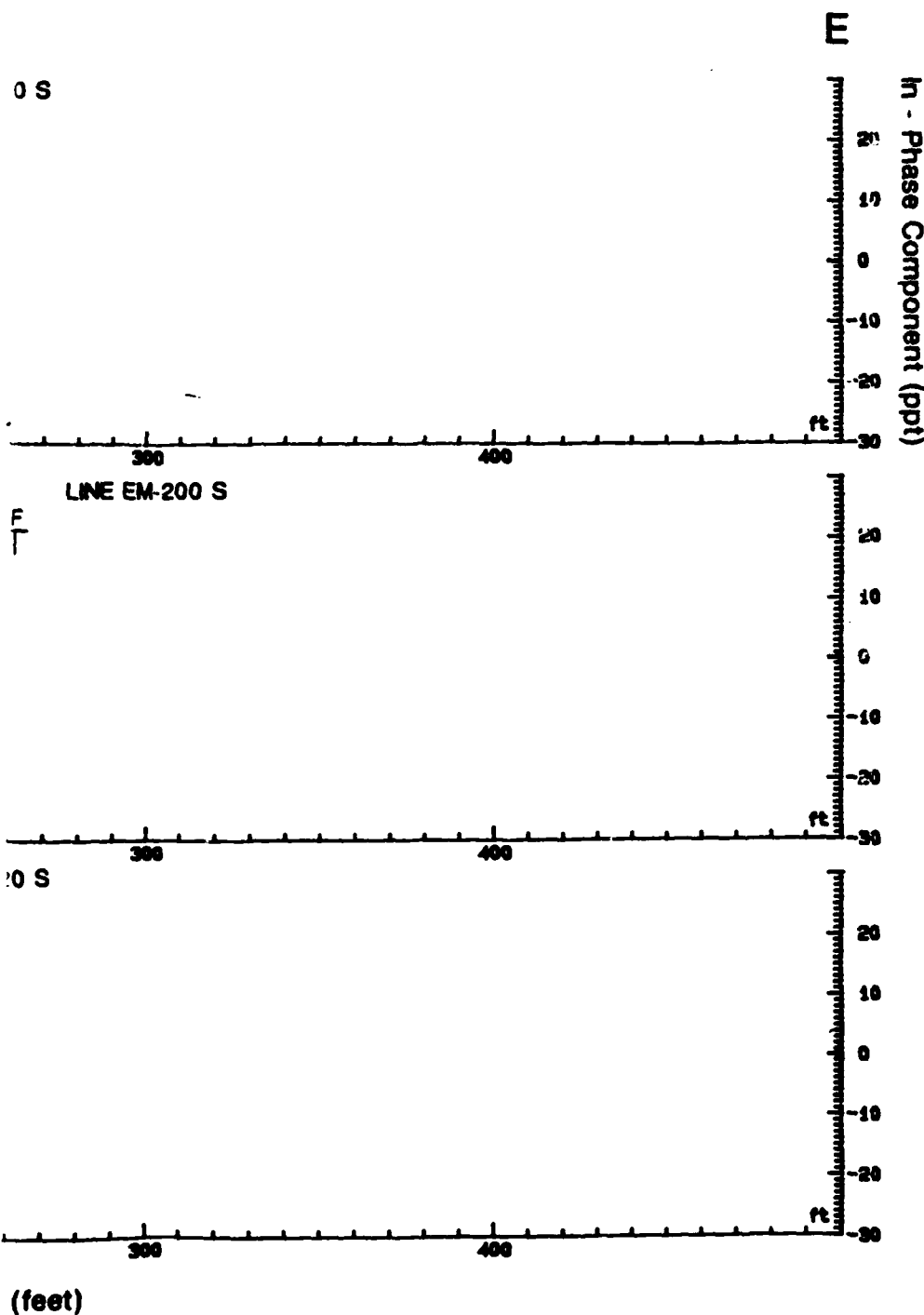
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CHECKED BY L.C.
APPROVED BY (signature)

DRAWN BY J. WALL
4-24-91



067400



LEGEND:

- B - BUILDING
 - BF - BLAST FENCE
 - F - FENCE
 - FH - FIRE HYDRANT
 - LP - LIGHT POLE
 - M - MANHOLE
 - P - UTILITY
 - RC - REINFORCED CONCRETE
 - C - CURB
 - V - VEHICLE
- CONDUCTIVITY -
MILLISIEMENS/METER (mS/m)
- - - IN-PHASE COMPONENT -
PARTS PER THOUSAND OF PRIMARY
ELECTROMAGNETIC FIELD (PPT)

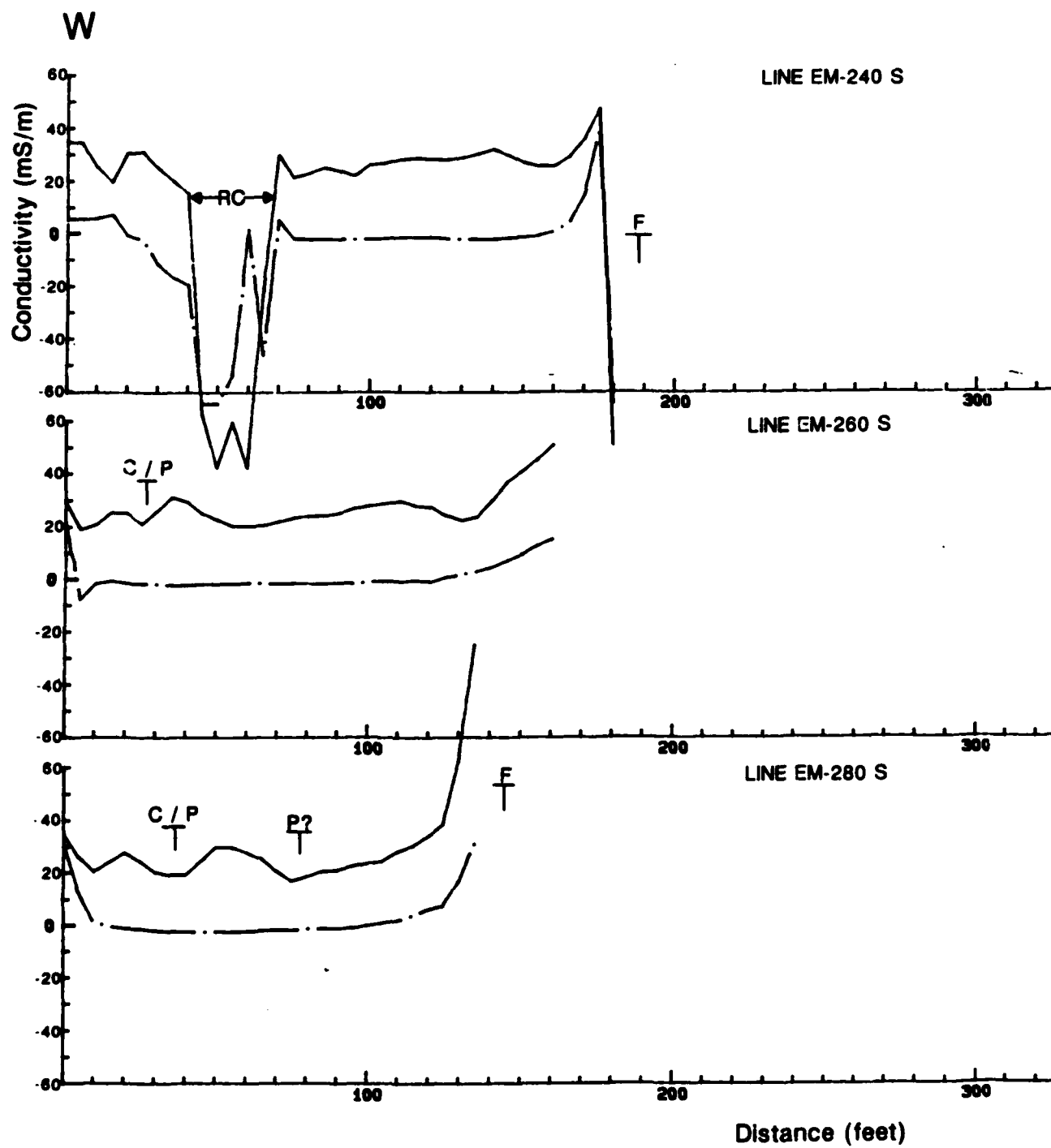
NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-4
ELECTROMAGNETIC INDUCTION PROFILES
SITE 5 - AMMUNITION DISPOSAL AREA
181 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA



DRAWN BY	J. WALL	CHECKED BY	L.C.	4/30/91	DRAWING NUMBER	409721-B16
				4-24-91		



40 S

0 S

0 S

(feet)

E

In - Phase Component (ppt)

ft

ft

ft

LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 C - CURB
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 — IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-5

ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
 161 AREFG

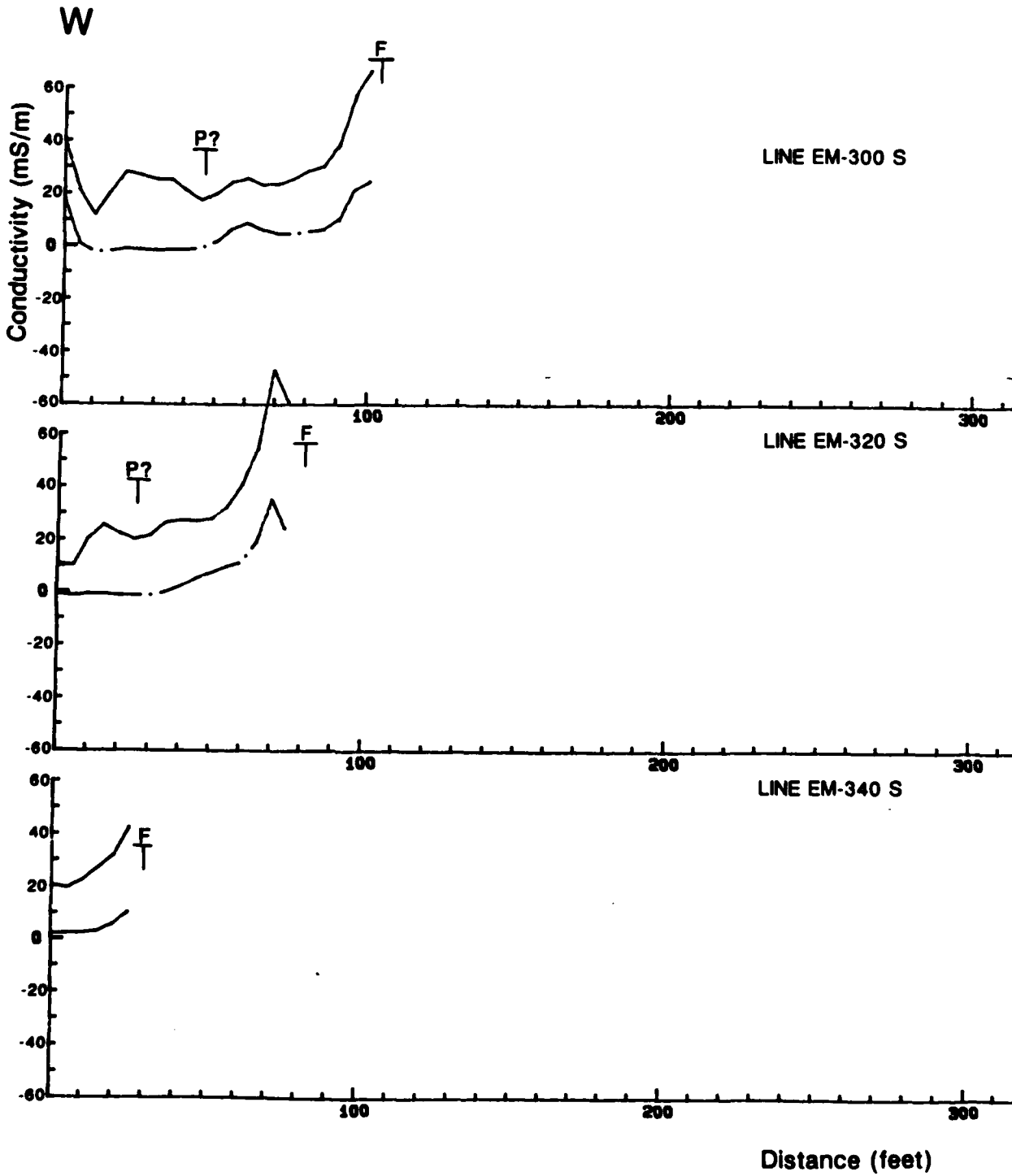
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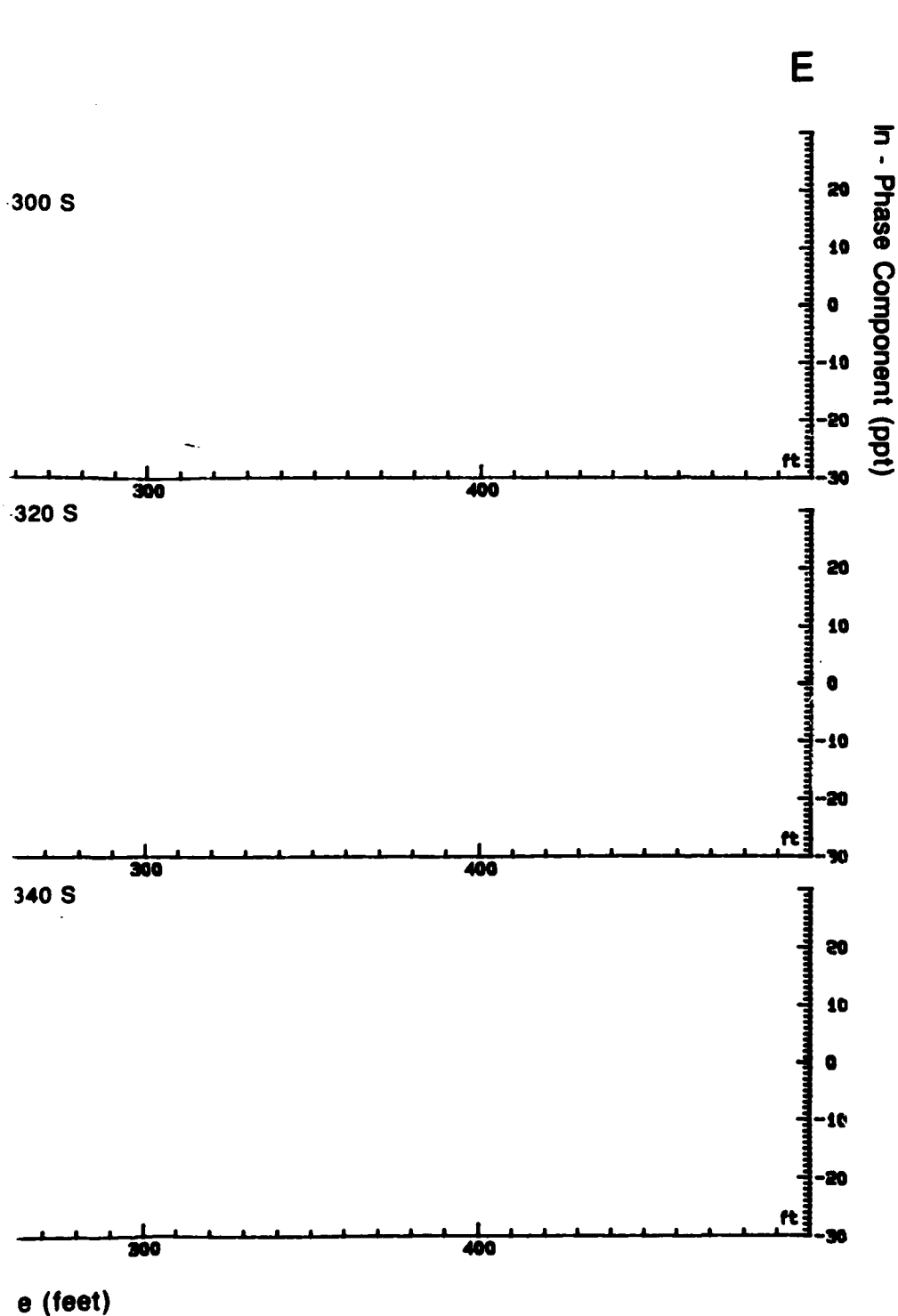
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APPROVED BY J.P.



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LEGEND:

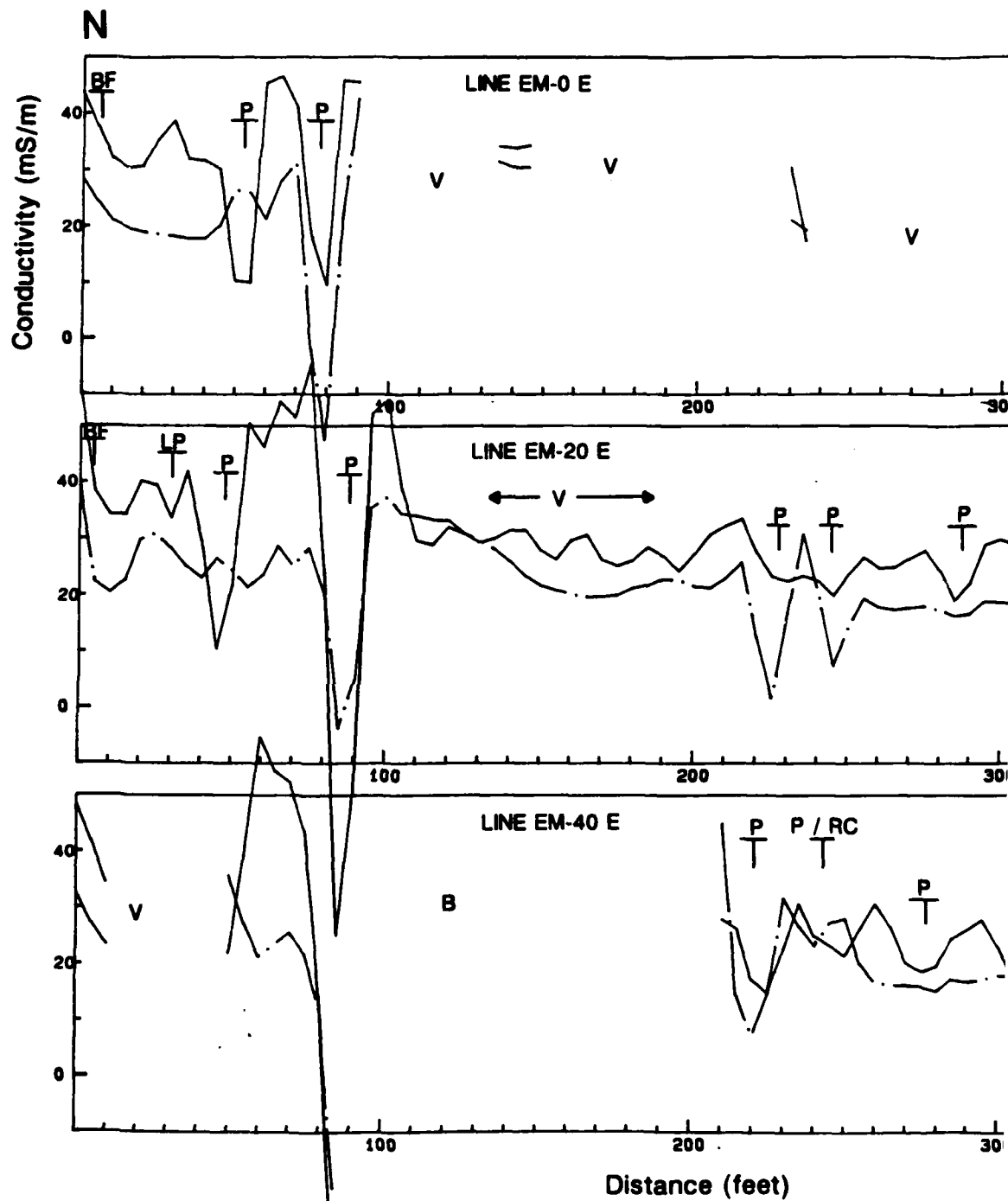
- B - BUILDING
 - BF - BLAST FENCE
 - F - FENCE
 - FH - FIRE HYDRANT
 - LP - LIGHT POLE
 - M - MANHOLE
 - P - UTILITY
 - RC - REINFORCED CONCRETE
 - S - SEWER
 - V - VEHICLE
- CONDUCTIVITY -
MILLISIEMENS/METER (mS/m)
- IN-PHASE COMPONENT -
PARTS PER THOUSAND OF PRIMARY
ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

FIGURE B-6
ELECTROMAGNETIC INDUCTION PROFILES
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

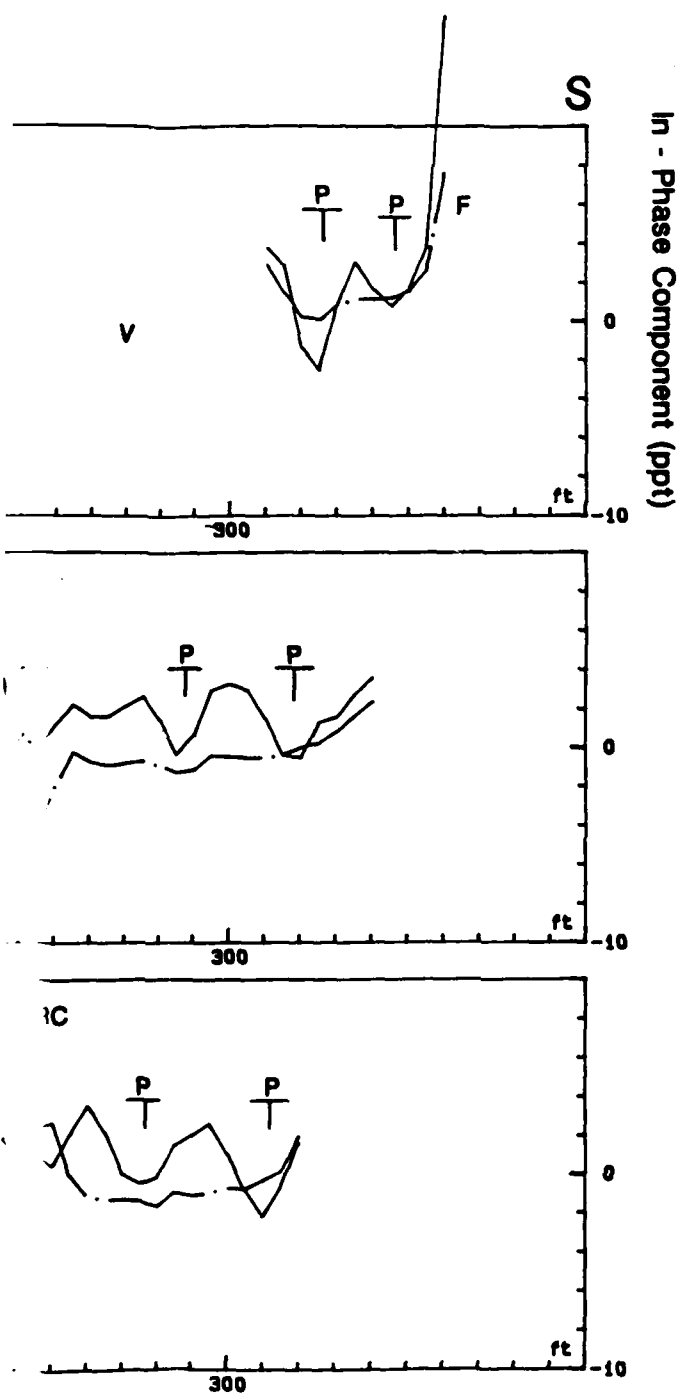
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				4-24-91		



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LEGEND:

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 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE(S)

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 - - - IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

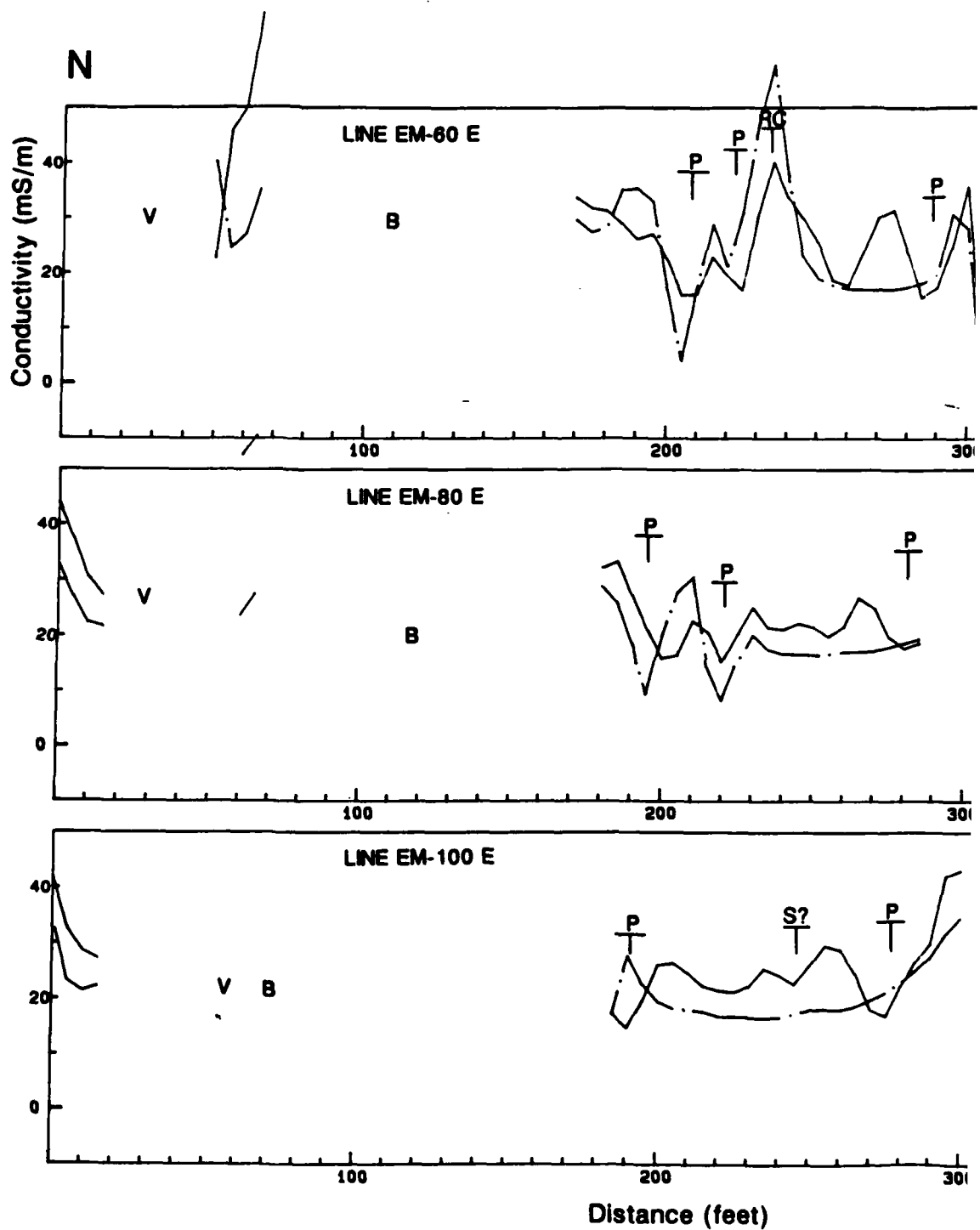
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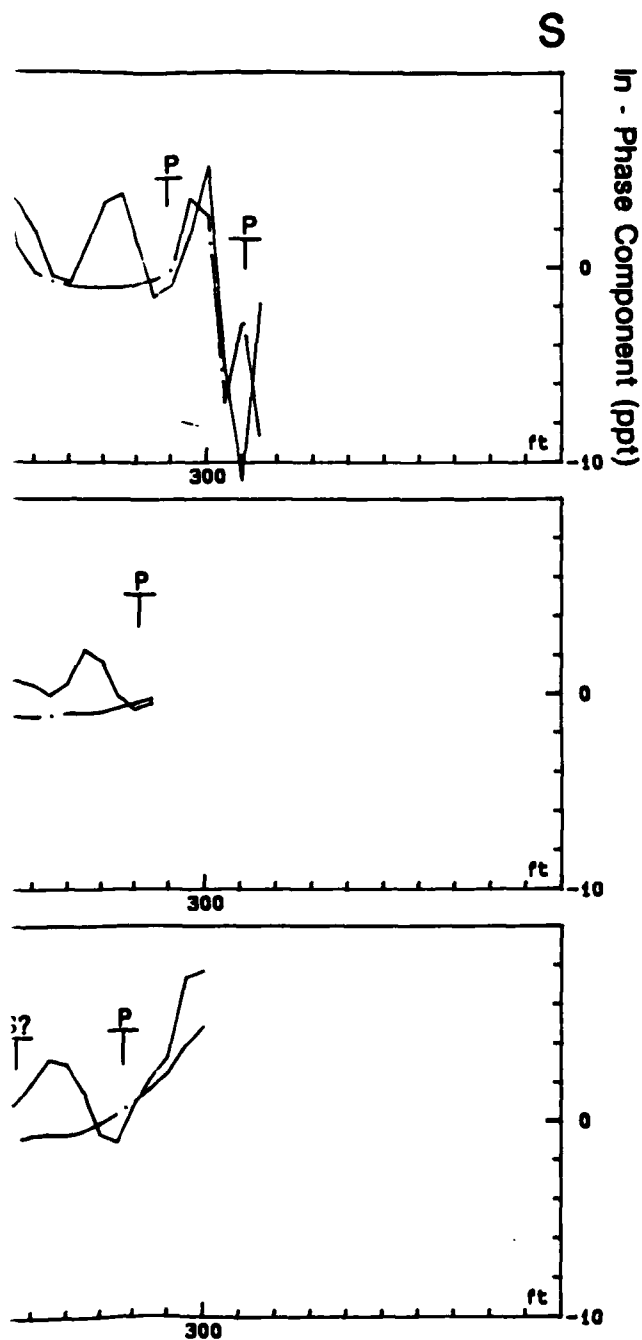
REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-7
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
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				4/24/91		





LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

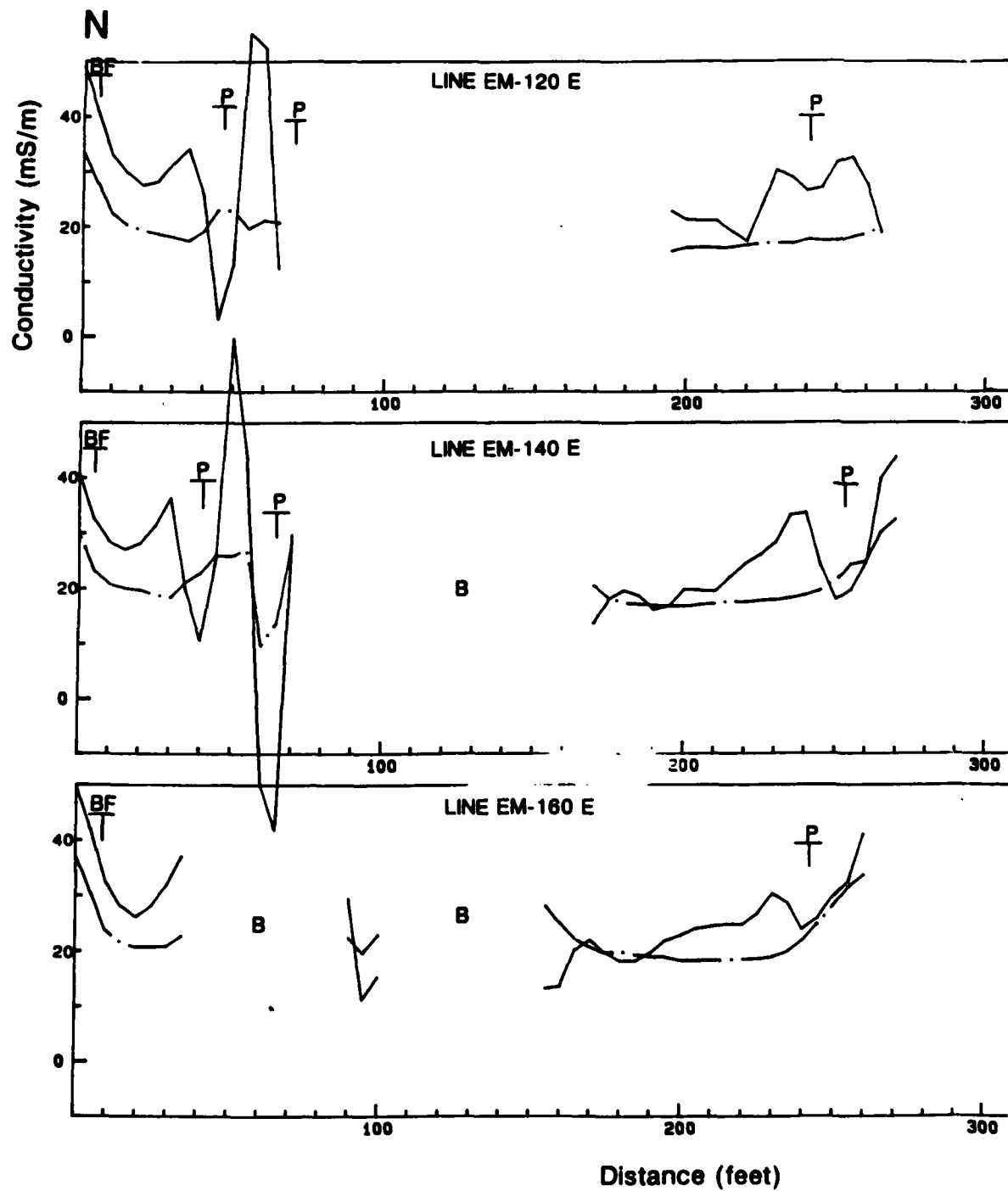
— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 - - - IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-8
ELECTROMAGNETIC INDUCTION PROFILES
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

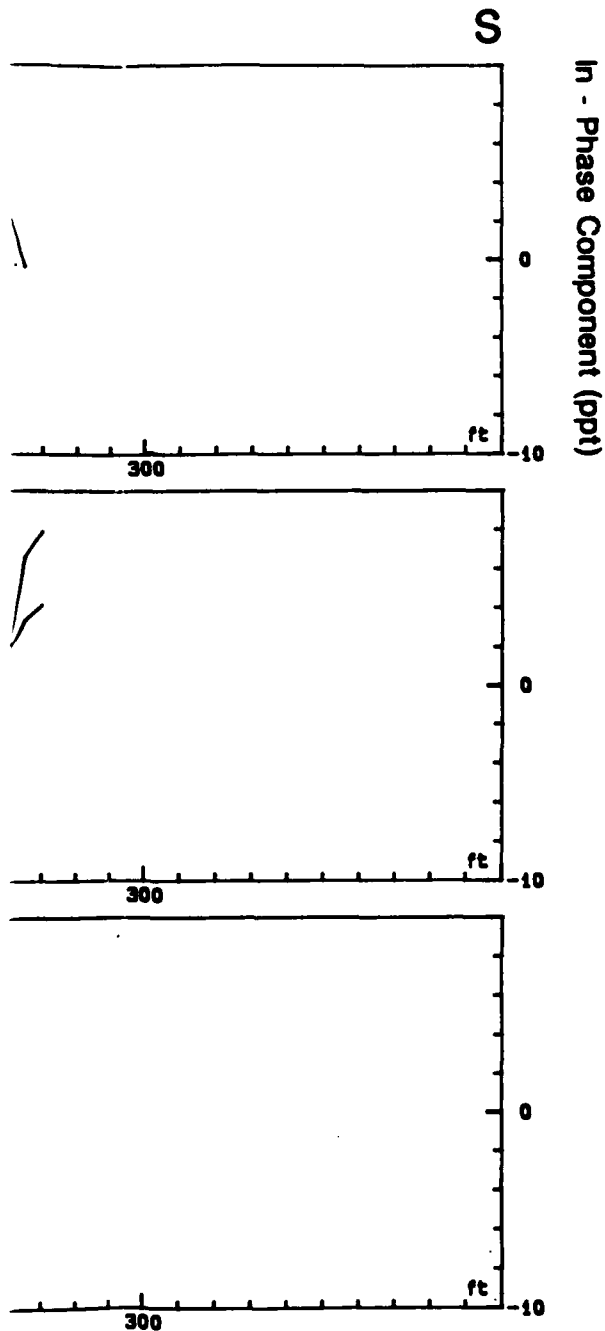
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LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 - - - IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

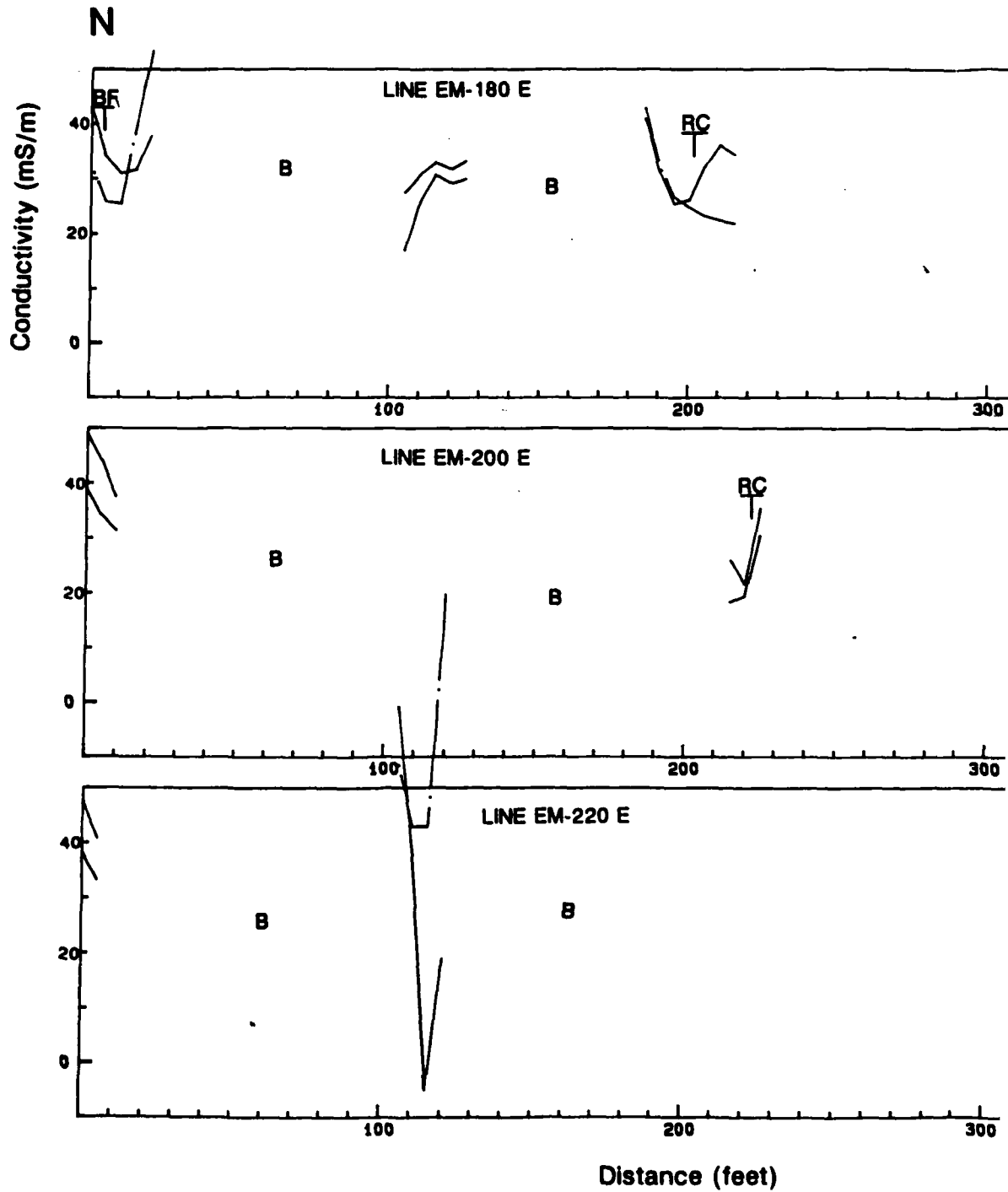
FIGURE B-9
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
 181 AREFG
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CHECKED BY L.A. 4/30/91

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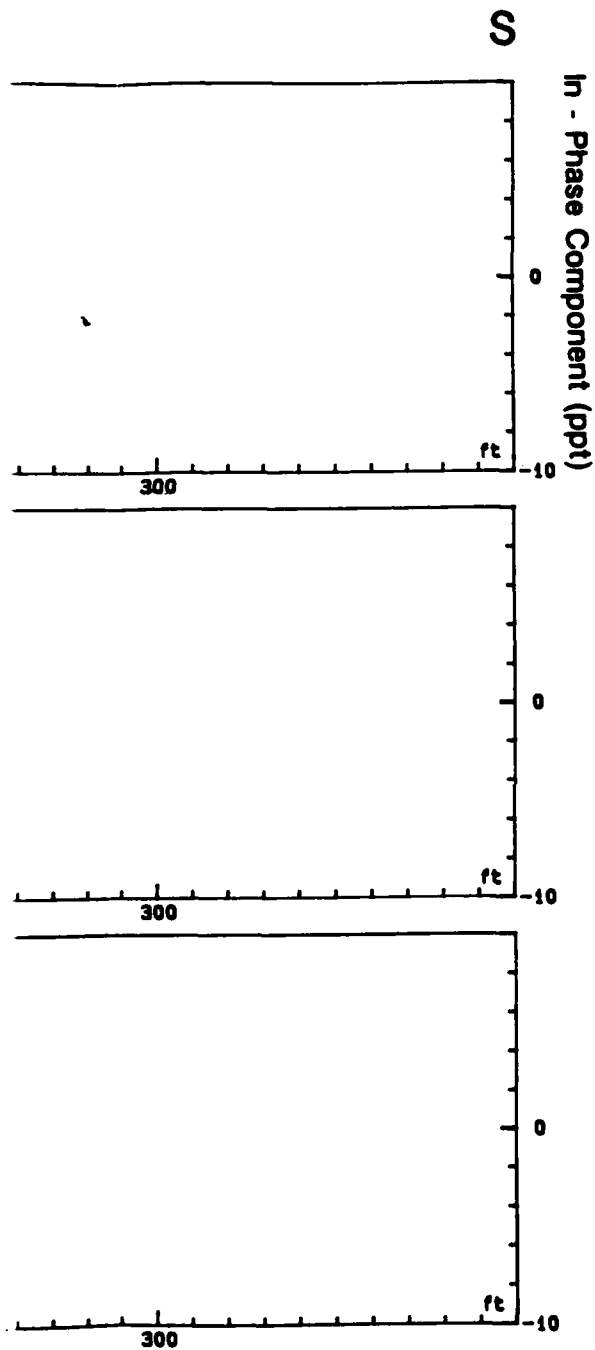
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LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 — IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-10
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
 161 AREFG
 SKY HARBOR IAP
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4/30/91

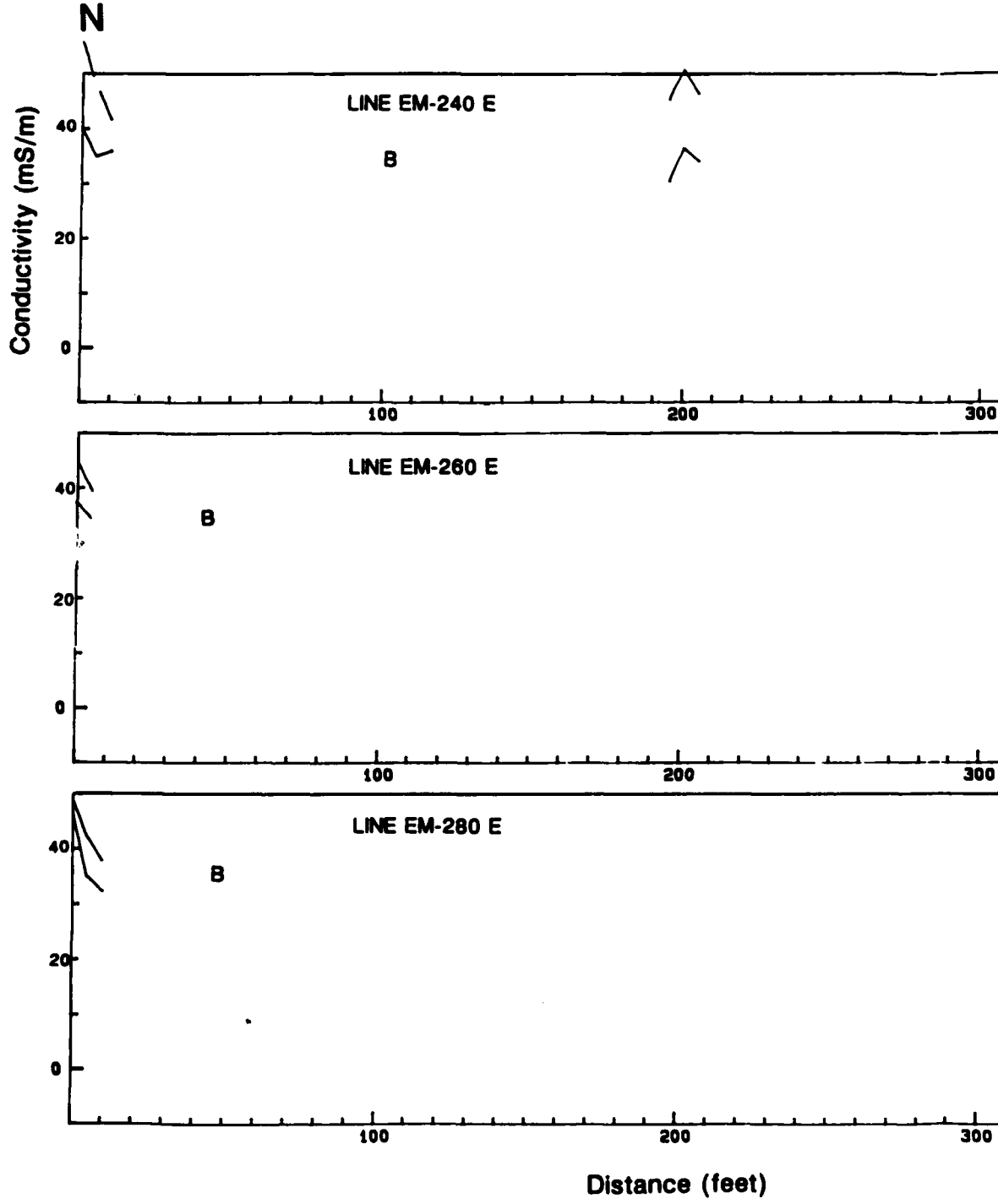
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4-24-81

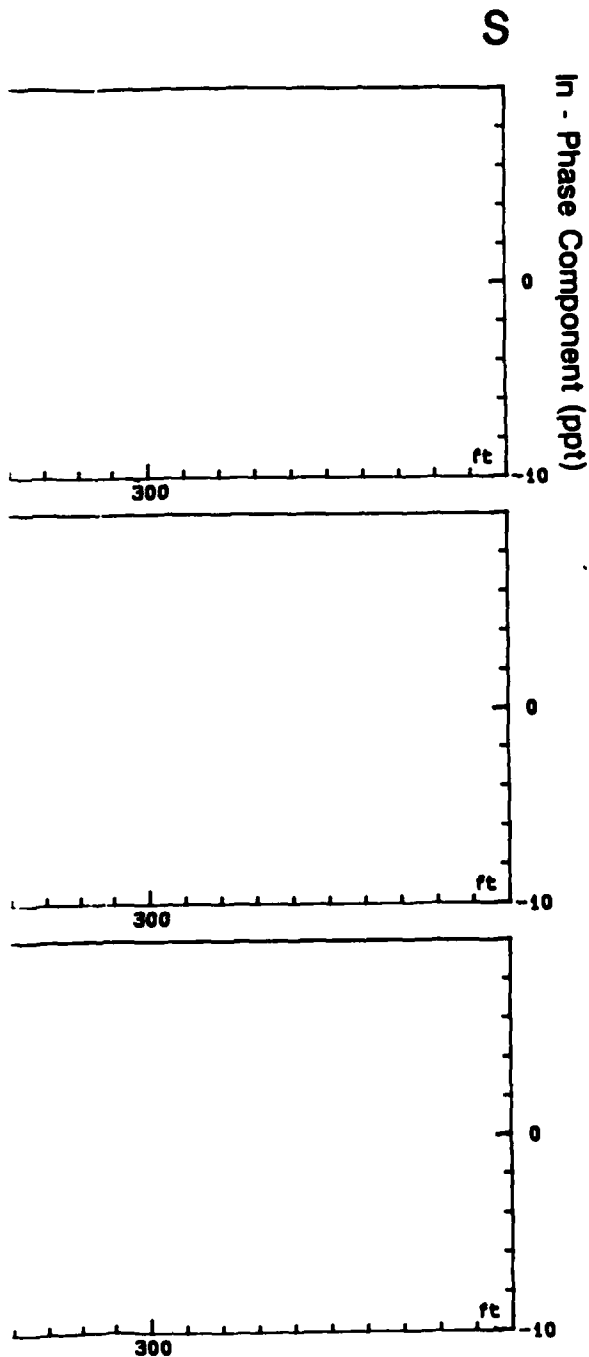
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B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISEMENS/METER (mS/m)
 — IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

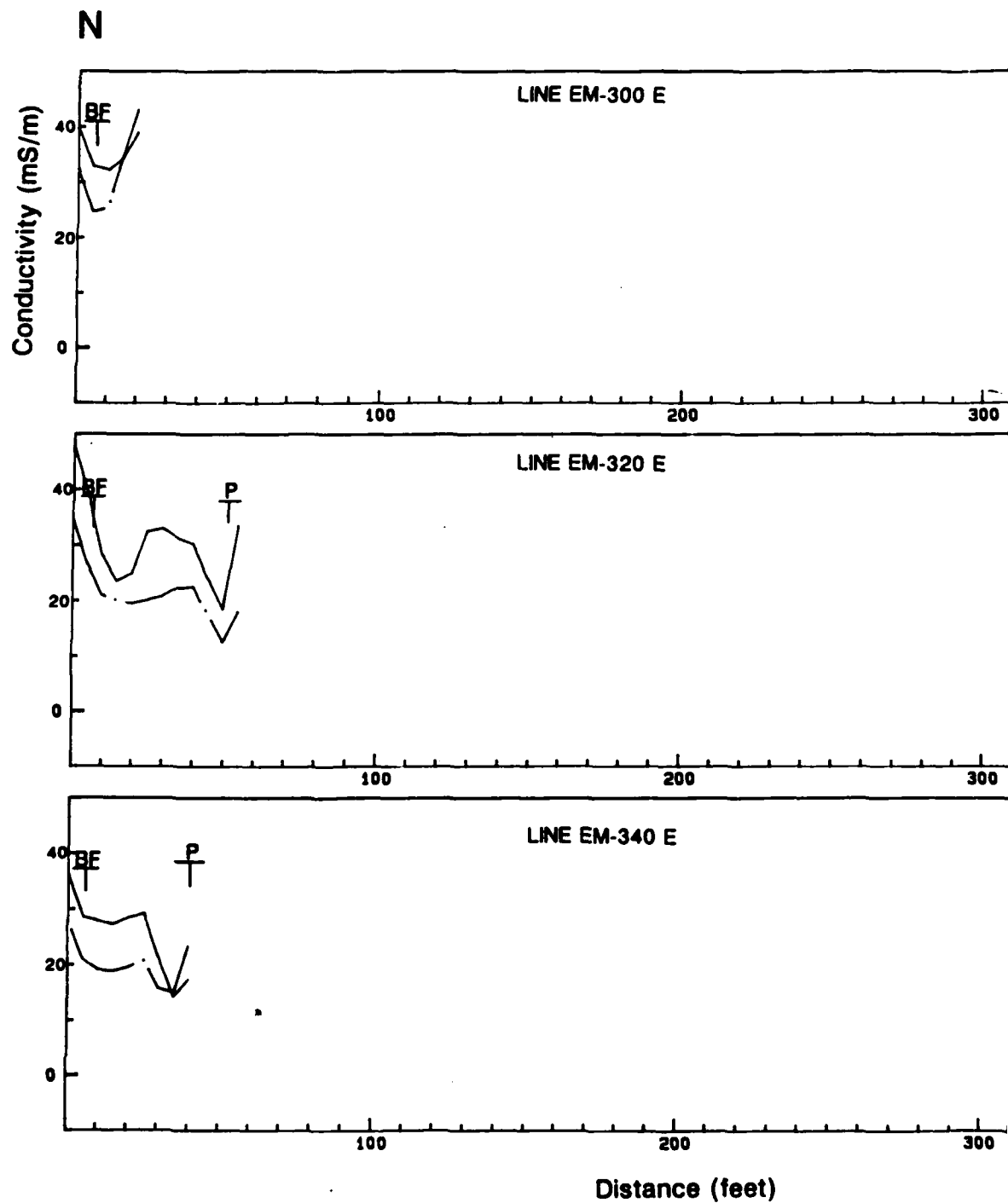
NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-11
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
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	BY	APPROVED BY	4/30/97				



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B - BUILDING
BF - BLAST FENCE
F - FENCE
FH - FIRE HYDRANT
LP - LIGHT POLE
M - MANHOLE
P - UTILITY
RC - REINFORCED CONCRETE
S - SEWER
V - VEHICLE

— CONDUCTIVITY -
MILLISIEMENS/METER (mS/m)
- - - IN-PHASE COMPONENT -
PARTS PER THOUSAND OF PRIMARY
ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
FOR LOCATION OF SURVEY LINES

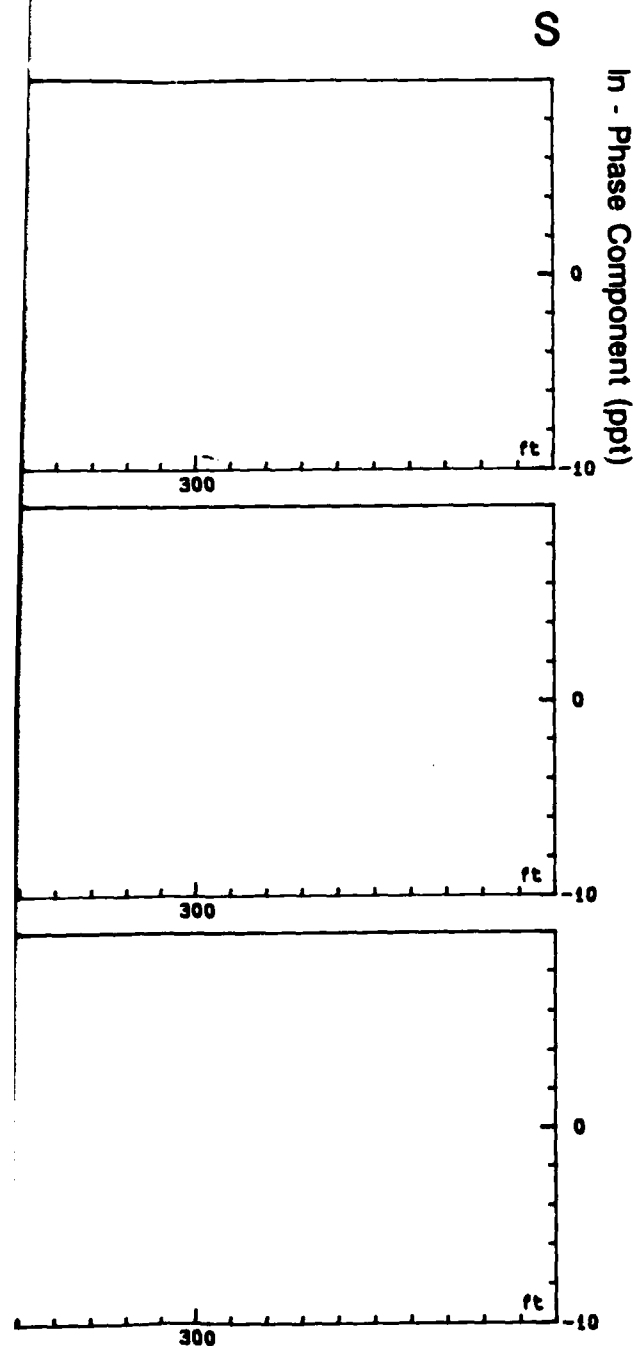


FIGURE B-12

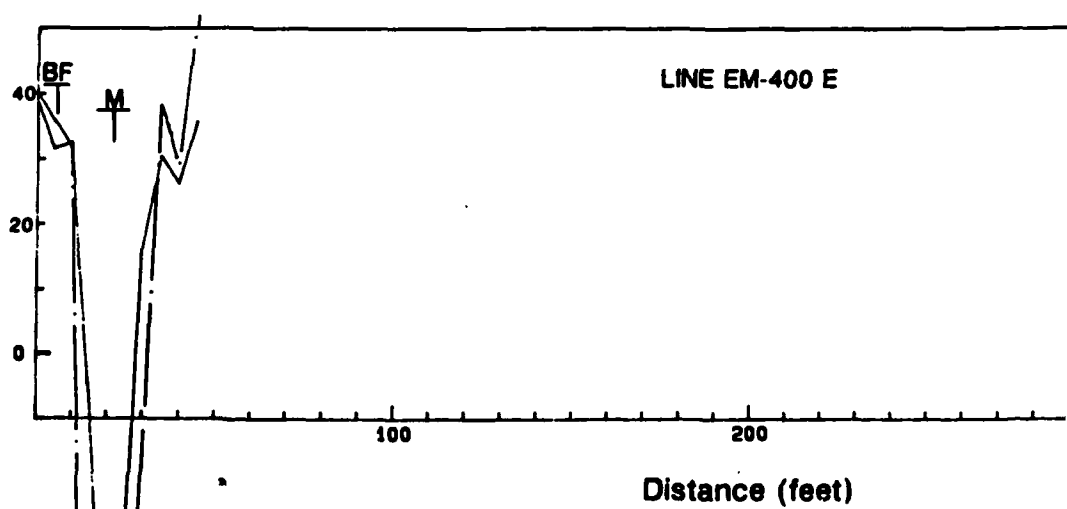
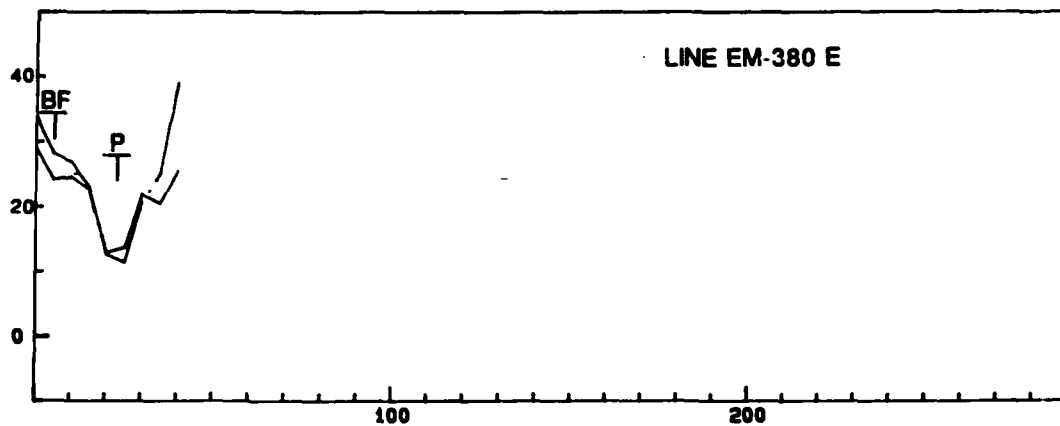
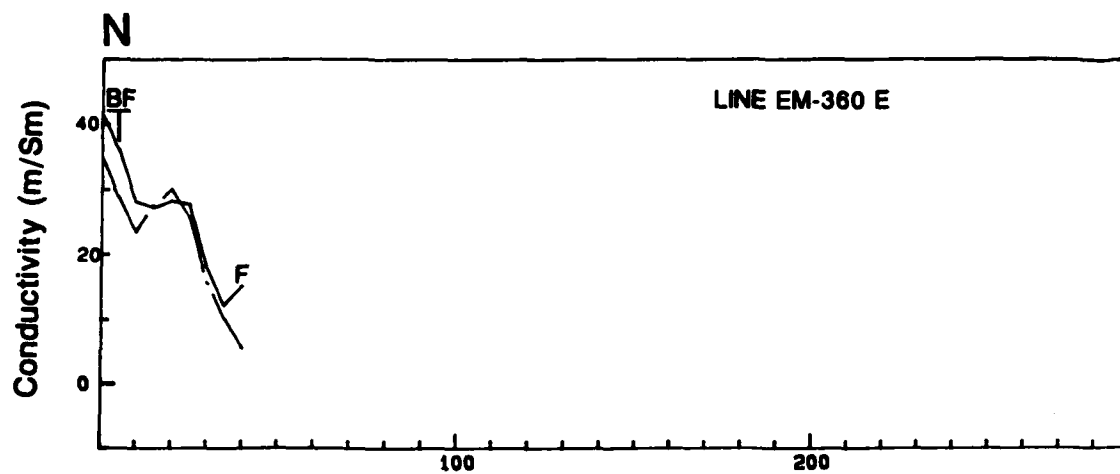
ELECTROMAGNETIC INDUCTION PROFILES

SITE 5 - AMMUNITION DISPOSAL AREA
181 AREFG

SKY HARBOR IAP
PHOENIX, ARIZONA

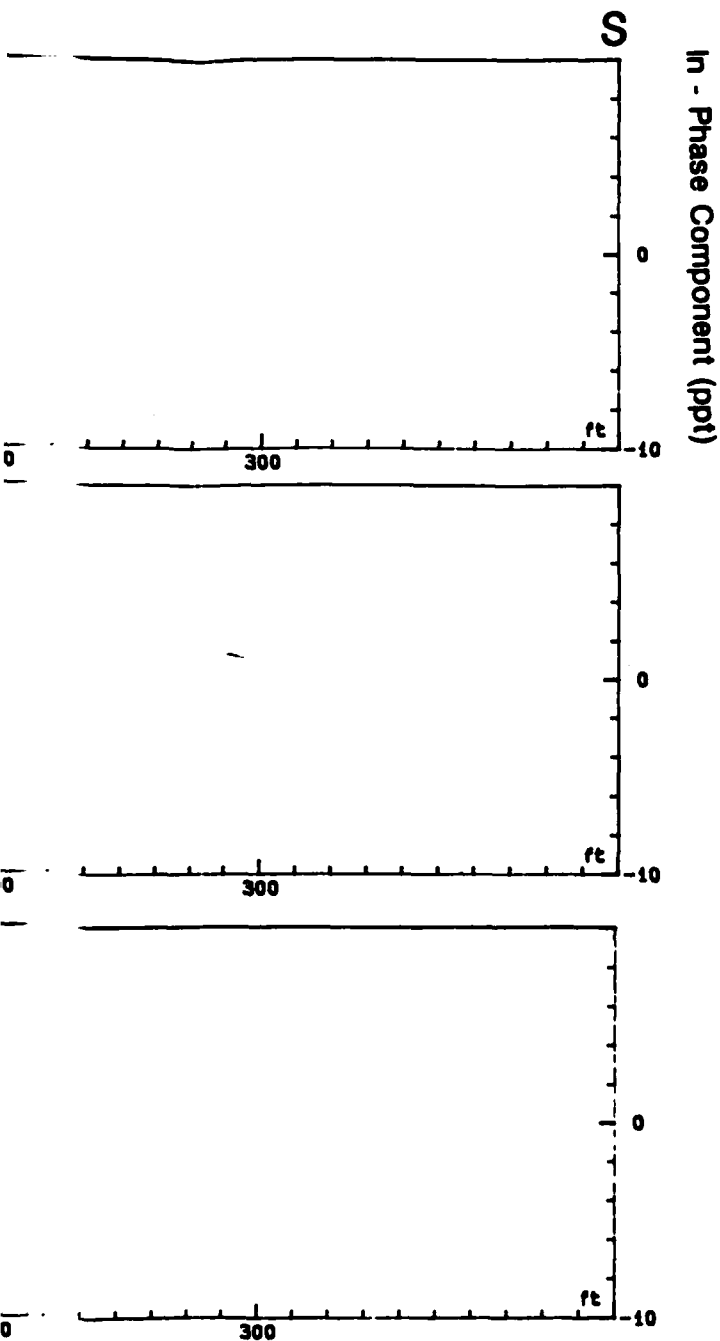


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LEGEND:

B - BUILDING
 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISIEMENS/METER (mS/m)
 — IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

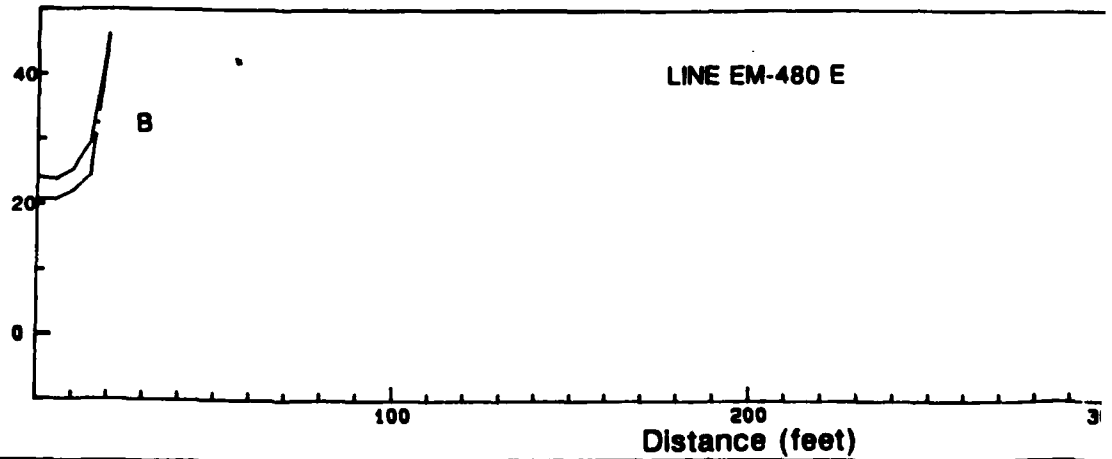
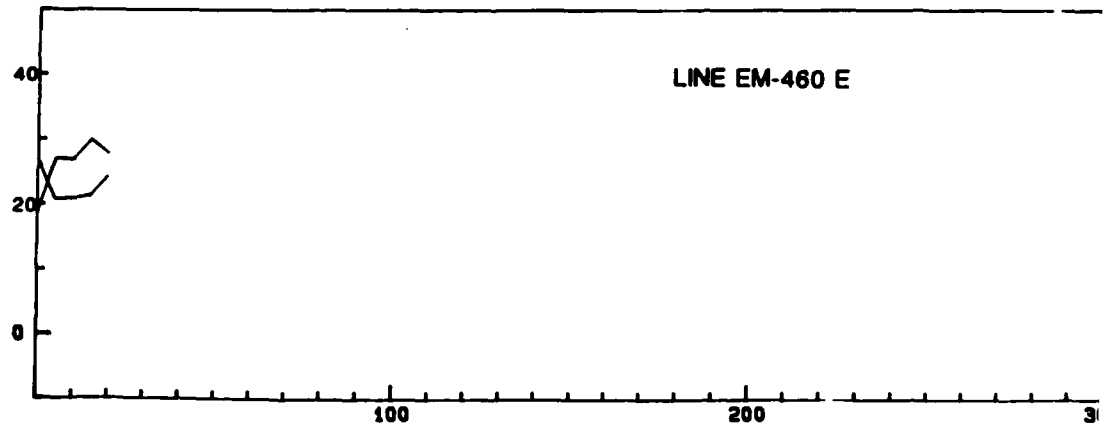
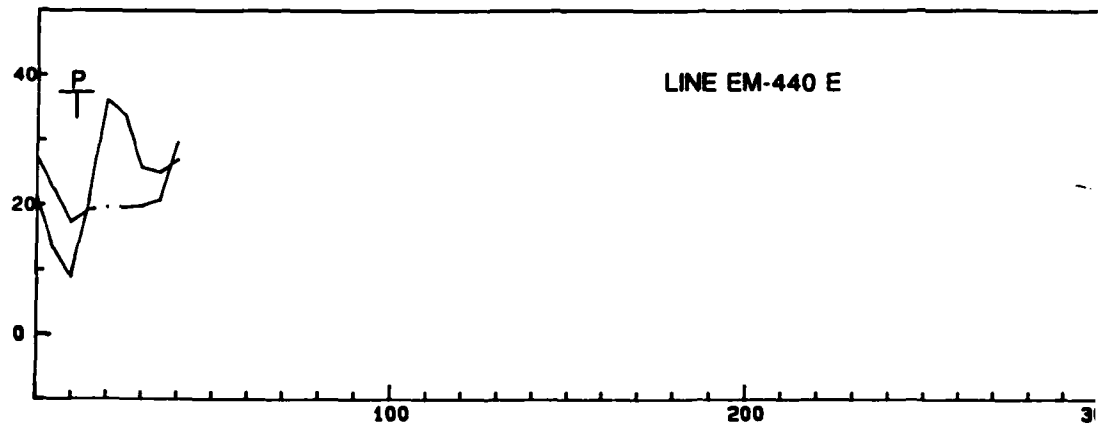
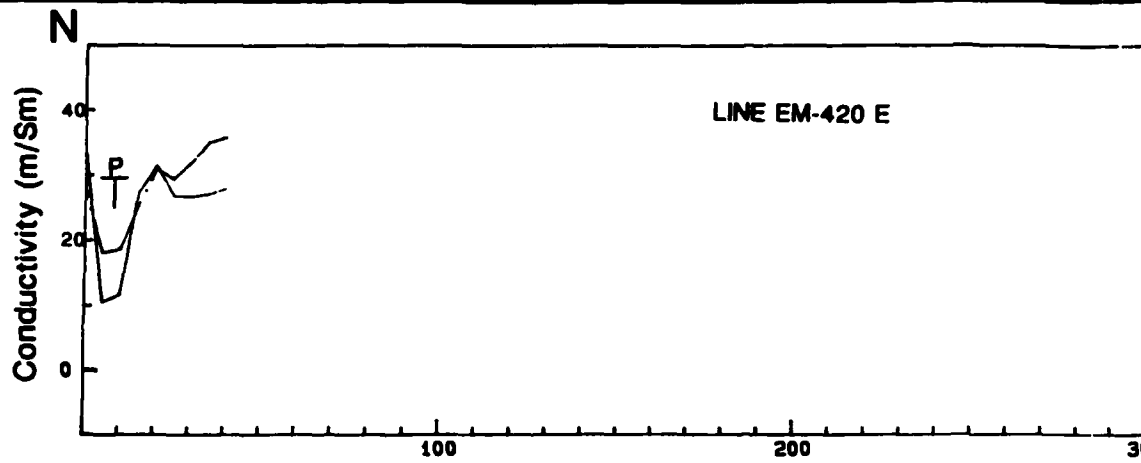
NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

FIGURE B-13
ELECTROMAGNETIC INDUCTION PROFILES
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

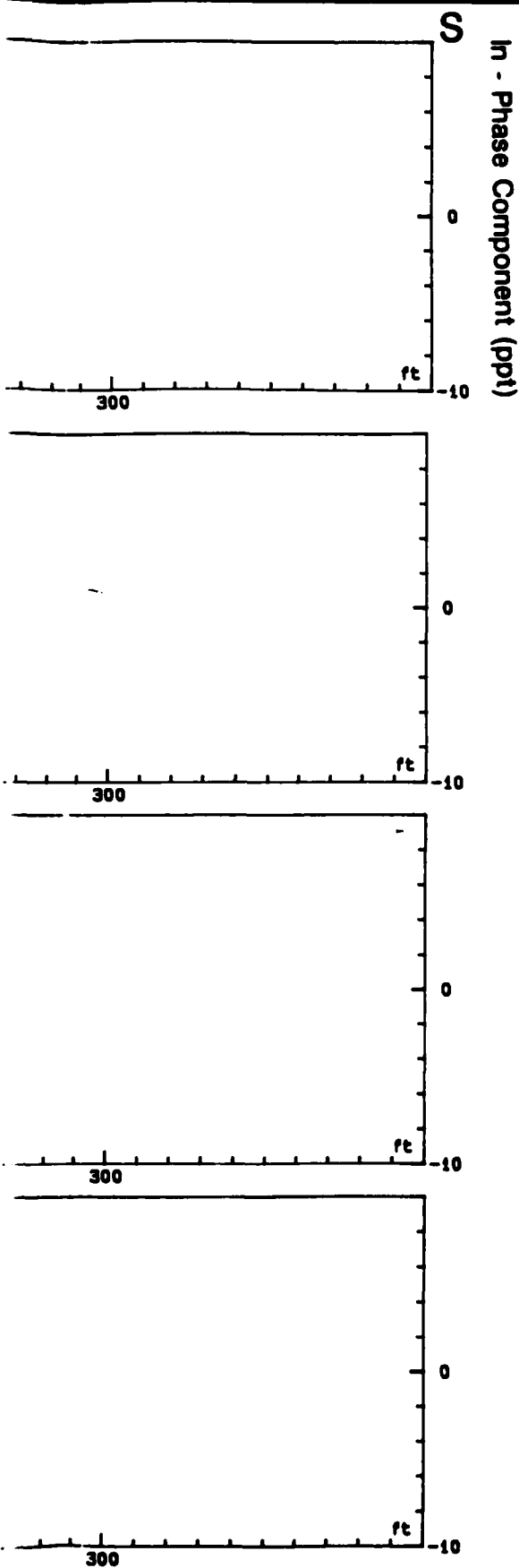


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				4/30/91		
APPROVED BY	4-24-91	APPROVED BY	4/30/91	4/30/91	DRAWING NUMBER	409721-B10



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LEGEND:

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 BF - BLAST FENCE
 F - FENCE
 FH - FIRE HYDRANT
 LP - LIGHT POLE
 M - MANHOLE
 P - UTILITY
 RC - REINFORCED CONCRETE
 S - SEWER
 V - VEHICLE

— CONDUCTIVITY -
 MILLISEMENS/METER (mS/m)
 - - - IN-PHASE COMPONENT -
 PARTS PER THOUSAND OF PRIMARY
 ELECTROMAGNETIC FIELD (PPT)

NOTE:

REFER TO FIGURE 1
 FOR LOCATION OF SURVEY LINES

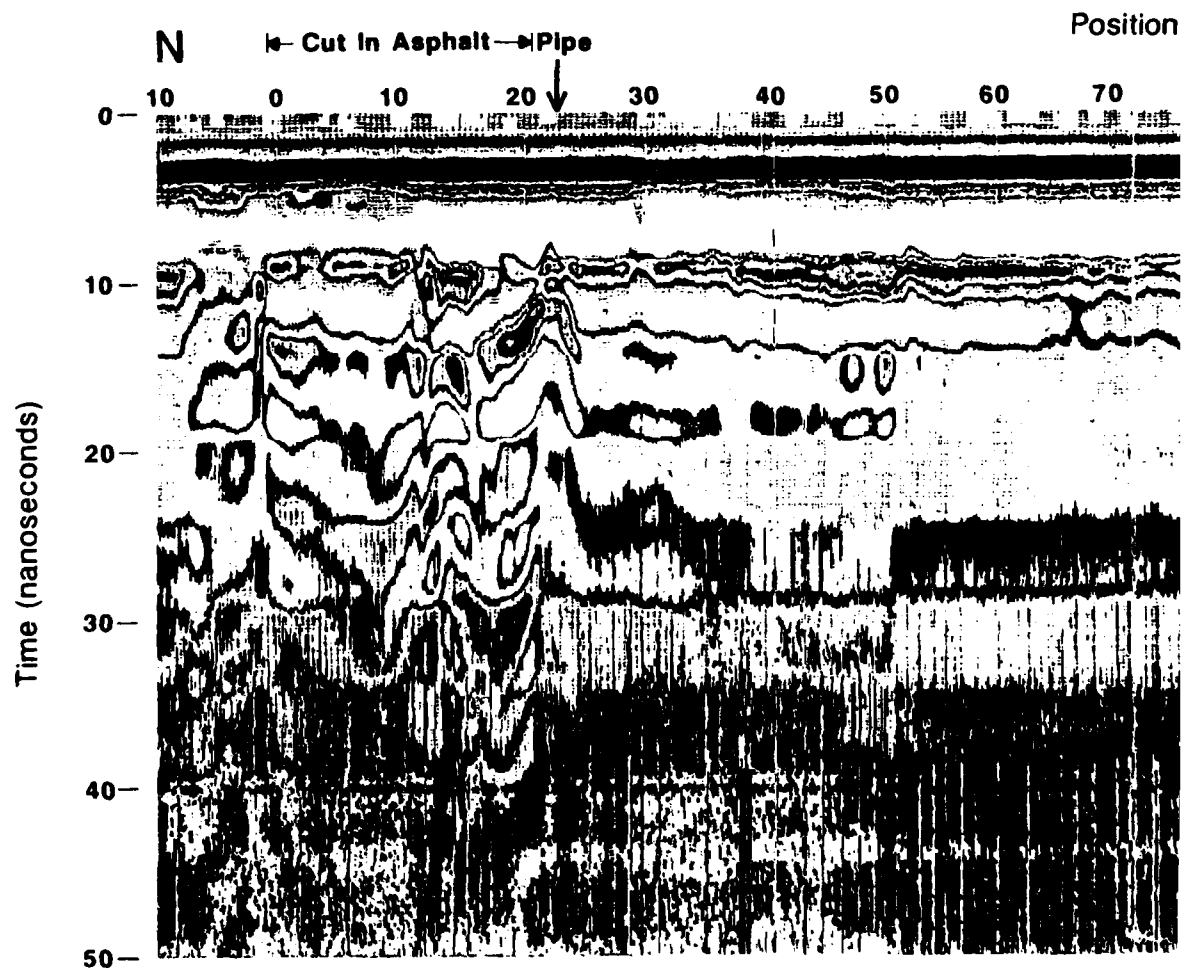
FIGURE B-14
 ELECTROMAGNETIC INDUCTION PROFILES
 SITE 5 - AMMUNITION DISPOSAL AREA
 161 AREFG
 SKY HARBOR IAP
 PHOENIX, ARIZONA



APPENDIX C

SELECTED GROUND PENETRATING RADAR RECORDS

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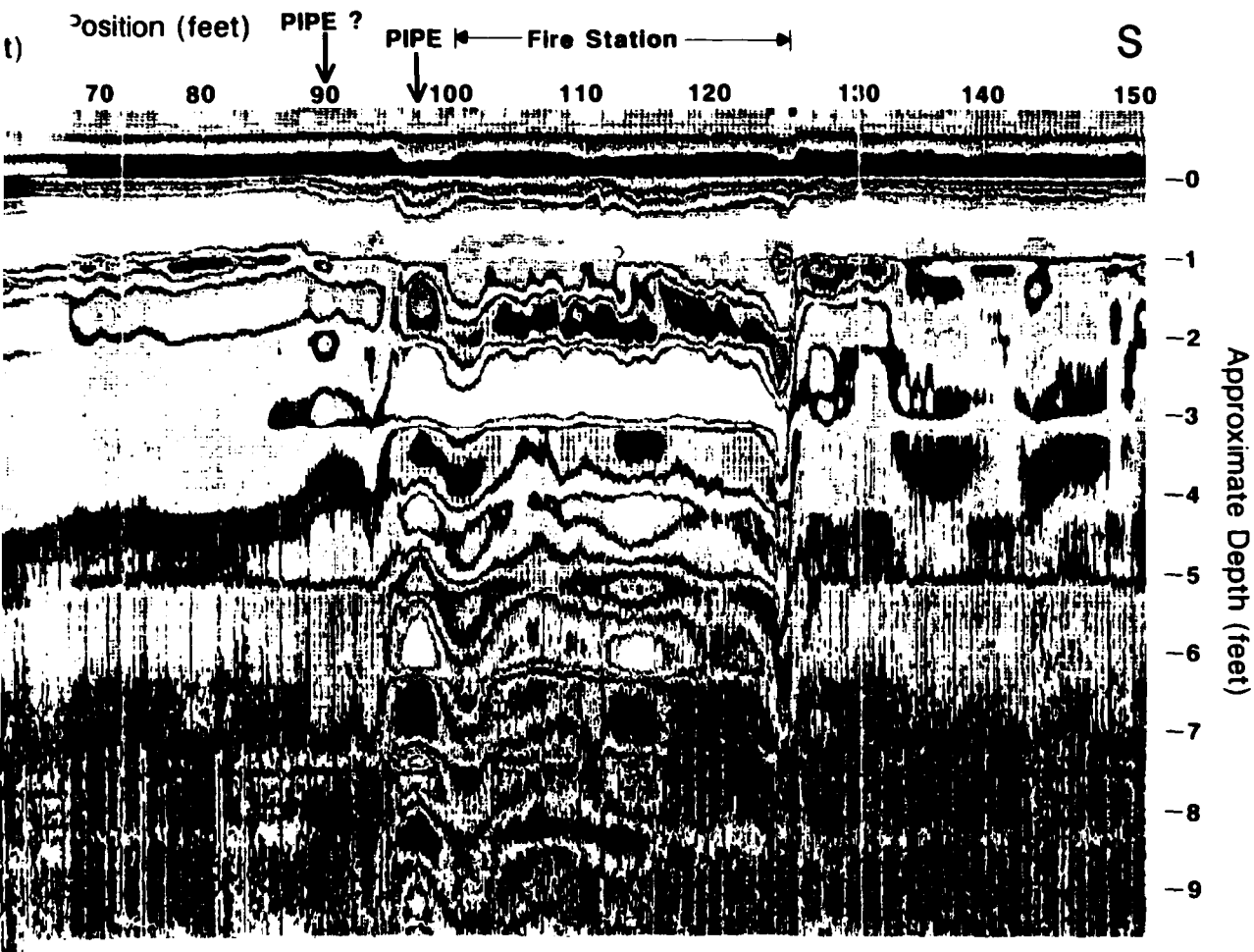


FIGURE C-1

GROUND PENETRATING RADAR

LINE 360 E, 300 MHz ANTENNA
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

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PHOENIX, ARIZONA

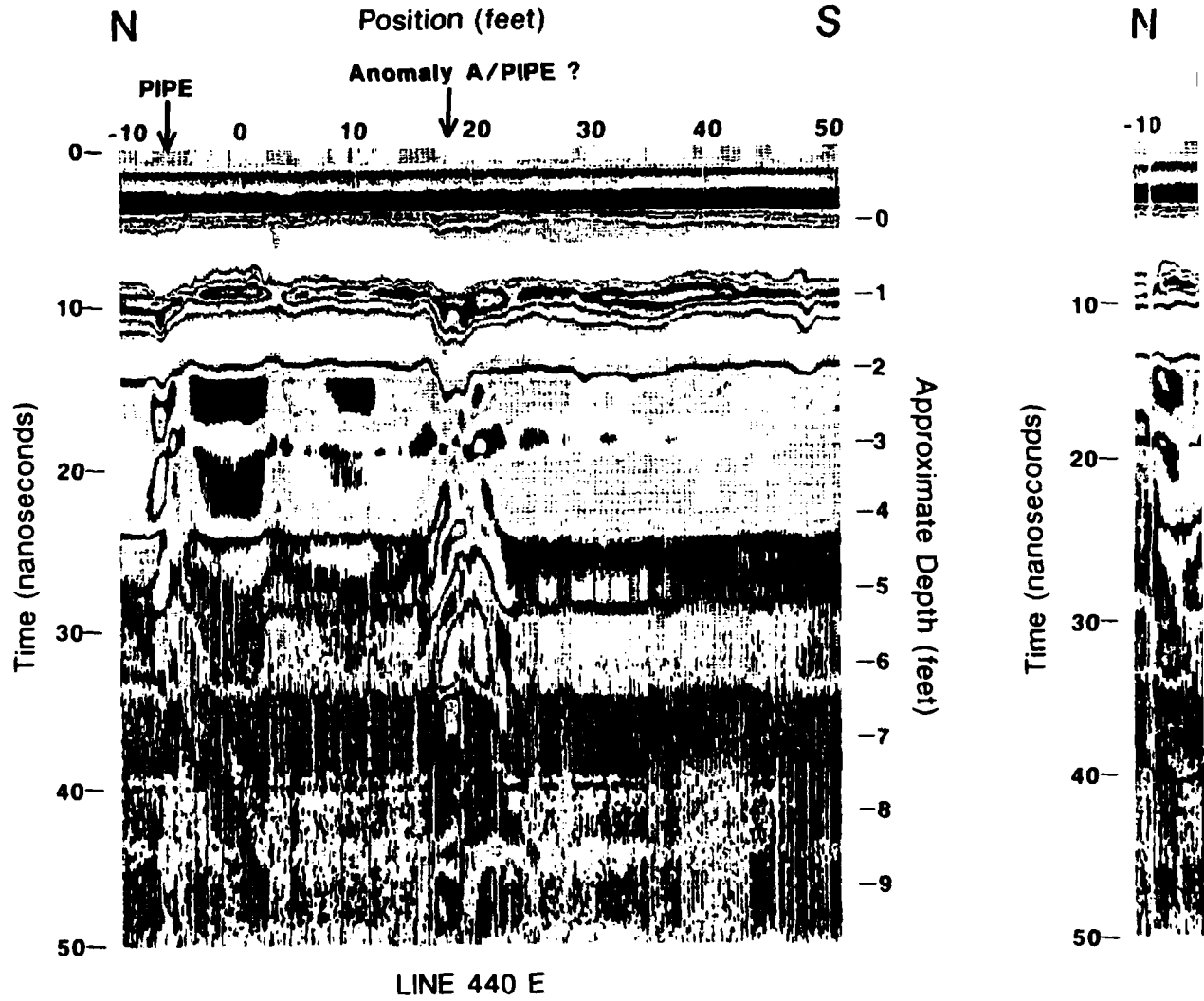
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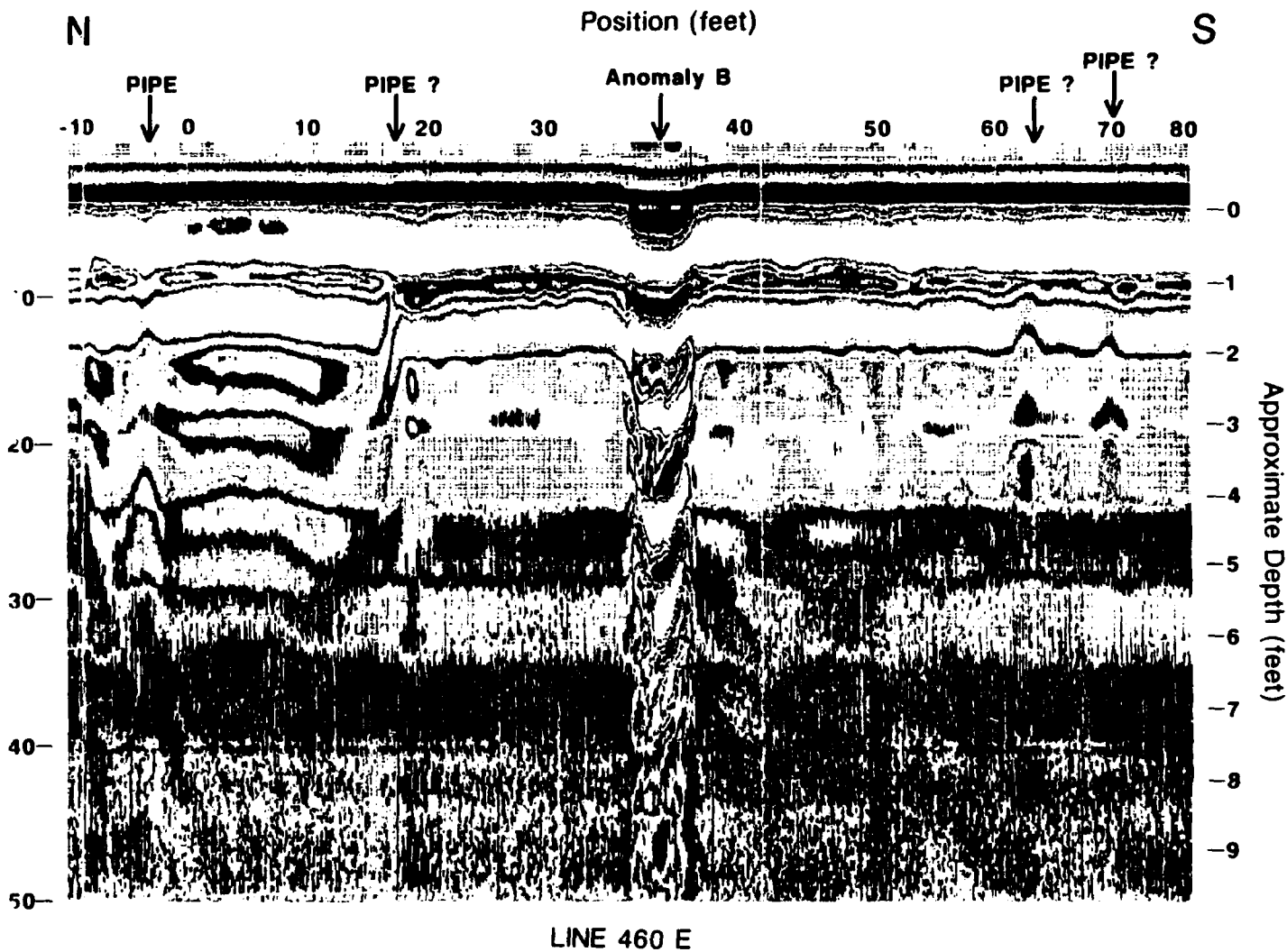


FIGURE C-2

GROUND PENETRATING RADAR

LINES 440 E & 460 E

300 MHz ANTENNA

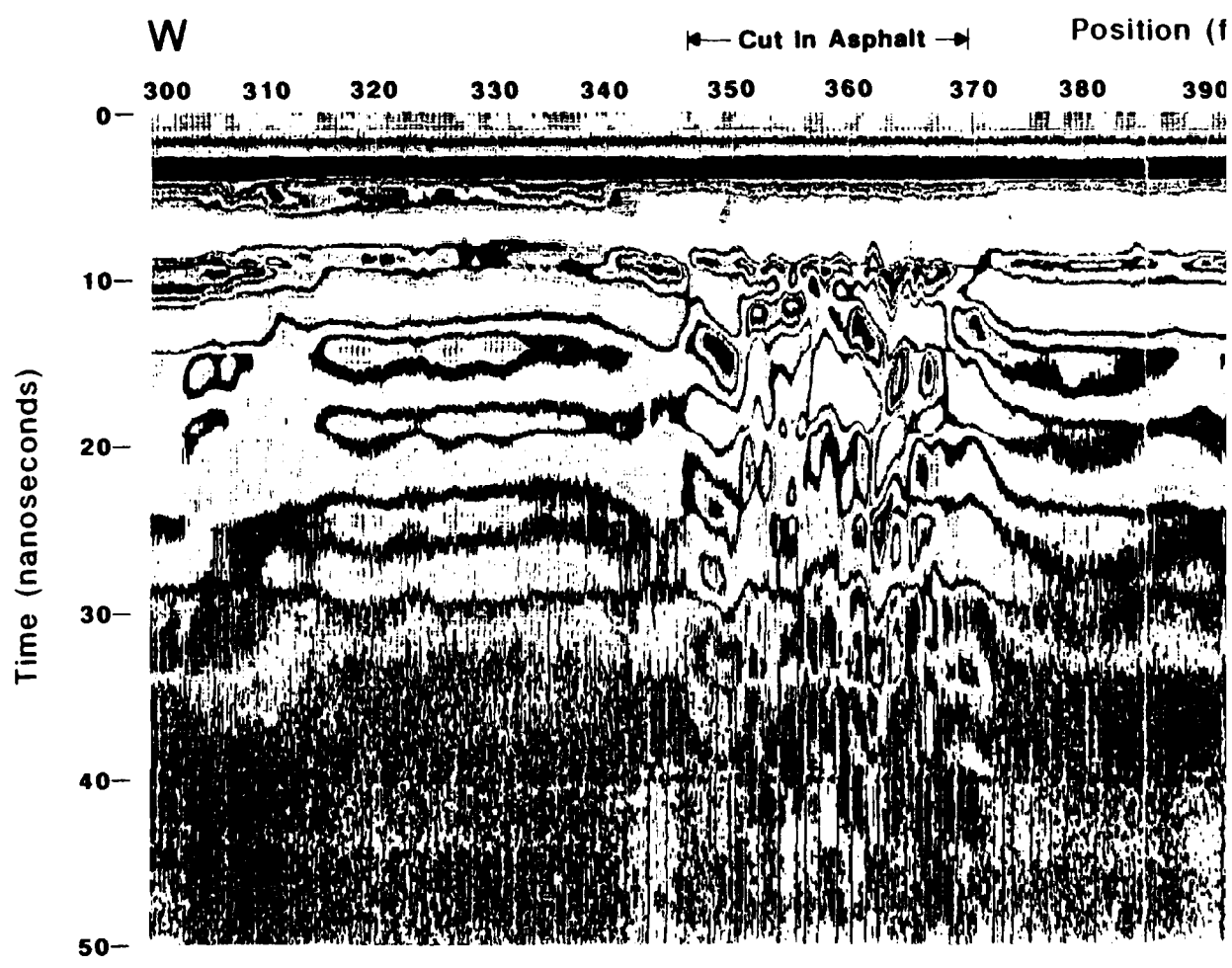
SITE 5 AMMUNITION DISPOSAL AREA
161 AREFG

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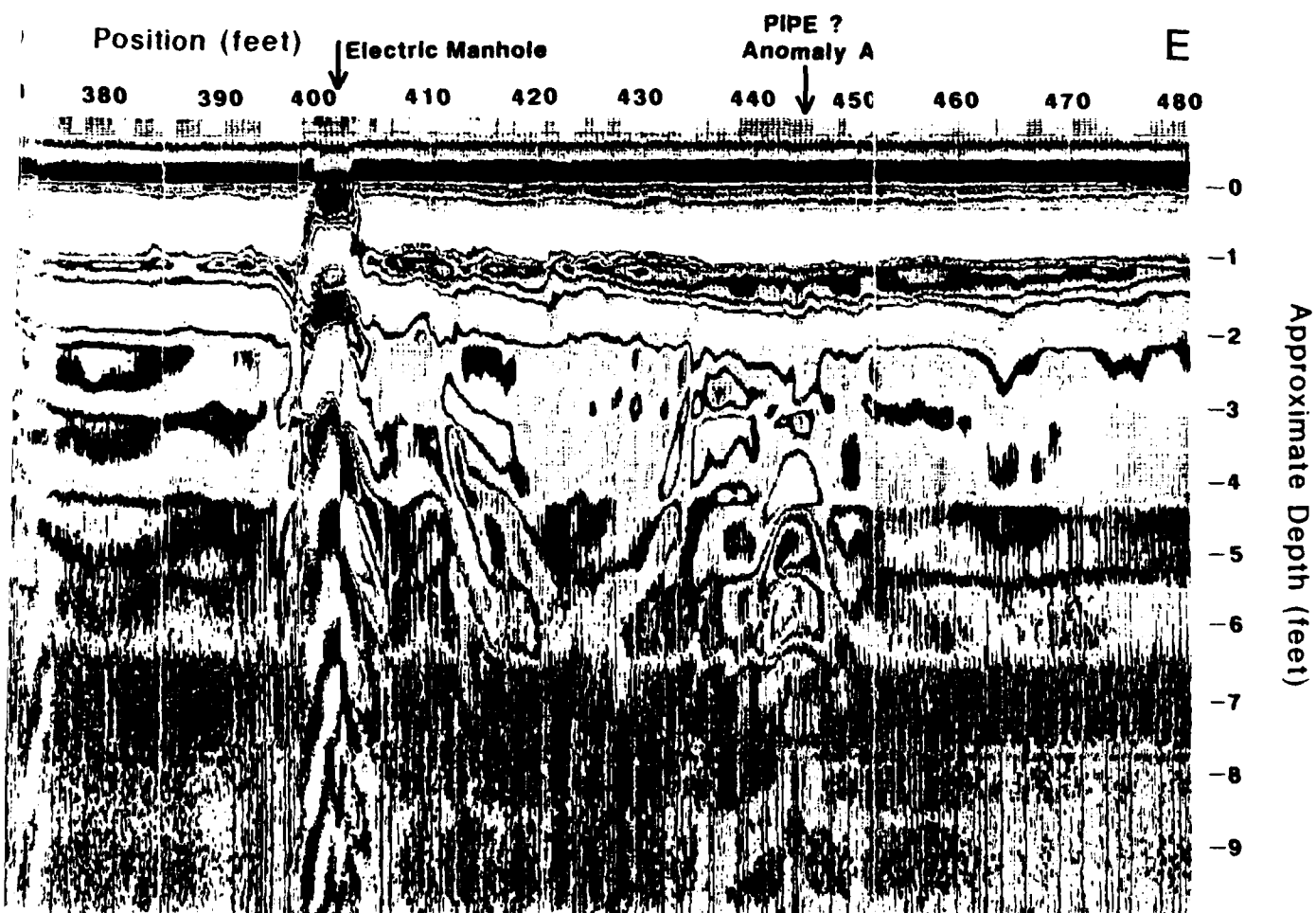


FIGURE C-3

GROUND PENETRATING RADAR

LINE 20 S, 300 MHz ANTENNA
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG

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4/30/91

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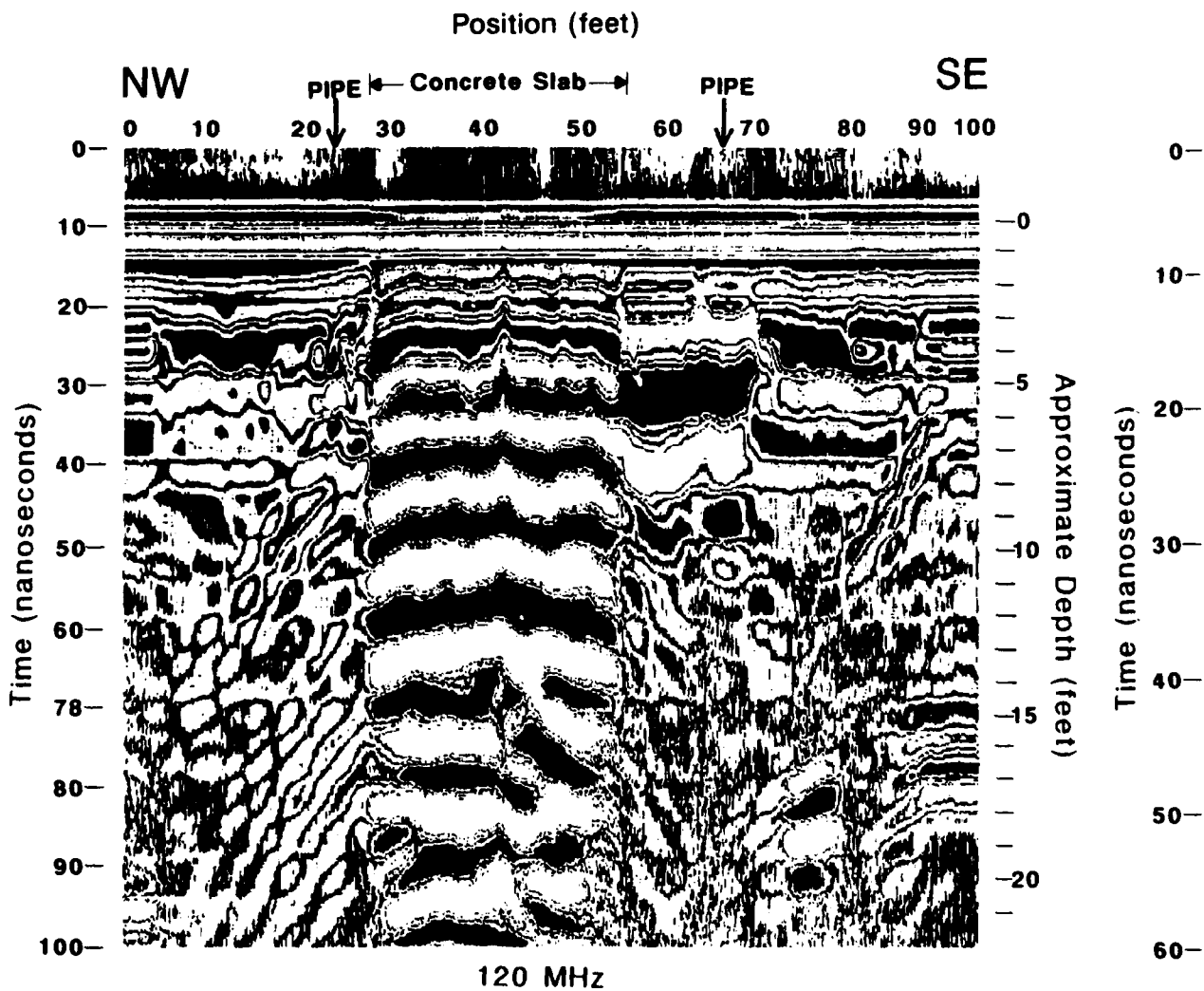
L.C.

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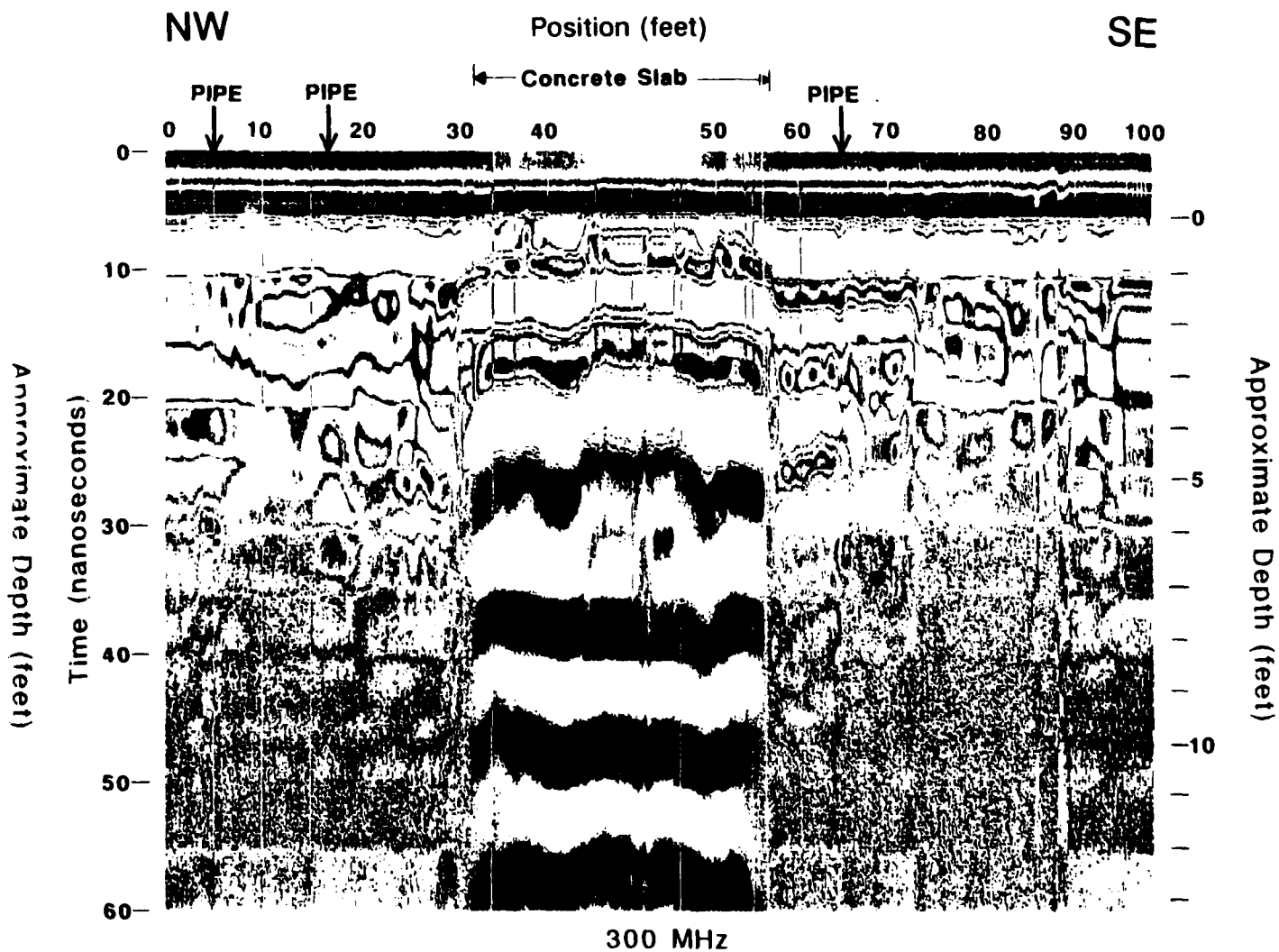


FIGURE C-4
GROUND PENETRATING RADAR
LINE GPR-4
120 AND 300 MHz ANTENNAE
SITE 5 - AMMUNITION DISPOSAL AREA
161 AREFG
SKY HARBOR IAP
PHOENIX, ARIZONA

APPENDIX D
SOV SURVEY REPORT

SOIL GAS SURVEY
SKY HARBOR AIR NATIONAL BASE
& PAPAGO MILITARY RESERVATION
PHOENIX, ARIZONA



TARGET ENVIRONMENTAL SERVICES, INC.

SOIL GAS SURVEY
SKY HARBOR AIR NATIONAL BASE
& PAPAGO MILITARY RESERVATION
PHOENIX, ARIZONA

PREPARED FOR

IT CORPORATION
312 DIRECTORS DRIVE
KNOXVILLE, TENNESSEE

PREPARED BY

TARGET ENVIRONMENTAL SERVICES, INC.

9180 RUMSEY ROAD
COLUMBIA, MARYLAND 21045
(301) 992-6622

FEBRUARY 1991

EXECUTIVE SUMMARY

From January 15-17, 1991, **TARGET** Environmental Services, Inc. (**TARGET**) conducted a soil gas survey at the Sky Harbor Air National Guard Base and at the Papago Military Reservation, Phoenix, Arizona, as part of a site investigation. Samples were analyzed by GC/FID for petroleum hydrocarbons and by GC/ECD for chlorinated hydrocarbons.

Very low levels of FID Total Volatiles occurred in several locations in the JP-4 Hydrant Area and the Hazardous Waste Storage Area at the Sky Harbor Air National Guard Base and at the Papago Military Reservation. None of the standardized FID analytes were present above their 1 $\mu\text{g/l}$ detection limit in any of the areas at either site.

GC/ECD analysis indicated that relatively low levels of 1,1-dichloroethene (1,1-DCE) were present in samples collected from the JP-4 Hydrant Area and the Hazardous Waste Storage Area at the Sky Harbor Air National Guard Base. Tetrachloroethene (PCE) was observed in all field samples. However, since comparable levels were also observed in all Field Control Samples (indicating persistent carryover in the sampling equipment), it is questionable whether the concentrations present in the field samples accurately reflect conditions in the soil gas at the sampling locations. None of the other standardized halogenated hydrocarbons were present above their respective detection limit in any soil gas samples from either site.

Introduction

IT Corporation contracted Target Environmental Services, Inc. (TARGET) to perform a soil gas survey at three locations on the Sky Harbor National Guard Base and at one location on the Papago Military Reservation, both in Phoenix, Arizona, as part of a site investigation. The field and analytical phases of the work were performed from January 15-17, 1991.

Field Procedures

Soil gas samples were collected at a total of 32 locations at the three sites. Fourteen (14) samples were collected at Site 1 (JP-4 Hydrant Area), 11 with the hydraulic probe and 3 with the drive rod. Twelve (12) samples were collected in Site 2 (Hazardous Waste Storage Area), all using the hydraulic probe. Sampling was attempted but was unsuccessful in three locations in Site 3 (Fuel Bladder Area). Six (6) samples were collected at the hazardous waste collection area on the Papago Military Reservation, all with the drive rod. Sampling order is included in Table 1 and sampling depths are shown in Table 2.

To collect samples with the van-mounted hydraulic probe, the probe was used to advance connected 3' sections of 1" diameter threaded steel casing down to the sampling depth. Although the proposed sampling depth was 10', some samples were collected at shallower depths due to probe refusal. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge. A teflon line was inserted into the casing to the bottom of the hole, and the bottom-hole line perforations were

isolated from the up-hole annulus by an inflatable packer.

To collect samples with the drive rod, a 1/2 inch hole was produced to the sampling depth. Where pavement was present, an electric hammer drill was employed for penetration prior to using the drive rod. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge, and a stainless steel probe was inserted to the full depth of the hole and sealed off from the atmosphere.

Whether using the hydraulic probe or the drive rod, a sample of in-situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure (15 psig). The self-sealing vial was detached from the sampling system, packaged, labeled, and transported to the laboratory for analysis.

Prior to the day's field activities all sampling equipment, drive rods, and probes were decontaminated by washing with soapy water and rinsing thoroughly. Internal surfaces were flushed dry using pre-purified nitrogen, and external surfaces were wiped clean using clean paper towels.

Field control samples were collected at the beginning and end of each day's field activities and after finishing a day's sampling in an area. These QA/QC samples were obtained by inserting the probe tip into a tube flushed by a 20 psi flow of pre-purified nitrogen and collecting in the same manner as described above.

Laboratory Procedures

All of the samples collected during the field phase of the survey were subjected to dual analyses in the field in TARGET's climate-controlled mobile laboratory using a Shimadzu 14-A gas chromatograph.

The first analysis was conducted according to EPA Method 601 (modified) on a gas chromatograph equipped with an electron capture detector (ECD), but using direct injection instead of purge and trap. Specific analytes standardized for this analysis were:

1,1-dichloroethene (1,1-DCE)
1,1,1-trichloroethane (1,1,1-TCA)
tetrachloroethene (PCE)

Ten other halogenated hydrocarbons are also included in TARGET's standard gas mixture and are standardized in every analytical batch. These compounds (and their respective detection limits, in $\mu\text{g/l}$) are trichlorofluoromethane (0.05), methylene chloride (1.0), trans-1,2-dichloroethene (1.0), 1,1-dichloroethane (1.0), cis-1,2-dichloroethene (1.0), chloroform (0.10), carbon tetrachloride (0.05), trichloroethene (0.10), 1,1,2-trichloroethane (0.10), and 1,1,2,2-tetrachloroethane (0.1).

The second analysis was conducted according to EPA Method 602 (modified) on a gas chromatograph equipped with a flame ionization detector (FID), but using direct injection instead of purge and trap. The analytes selected for standardization in this analysis were:

benzene
toluene
ethylbenzene
meta- and para- xylene
ortho-xylene

These compounds were chosen because of their utility in evaluating the presence of fuel products, or petroleum based solvents.

The FID Total Volatiles values were generated by summing the areas of all chromatogram peaks and calculated using the instrument response factor for toluene. Injection peaks, which also contain the light hydrocarbon methane, were excluded to avoid the skewing of the Total Volatiles (Totals) values due to injection disturbances and biogenic methane. For samples with low hydrocarbon concentrations, the calculated Total Volatiles concentration is occasionally lower than the sum of the individual analytes. This is because the response factor used for the Total Volatiles calculation is a constant, whereas the individual analyte response factors vary with concentration. It is important to understand that the Total Volatiles levels reported are relative, not absolute, values.

The analytical equipment was calibrated using an instrument-response curve and injection of known concentrations of the above standards. Retention times of the standards were used to identify the peaks in the chromatograms of the field samples and their response factors were used to calculate the analyte concentrations. The tabulated results of the laboratory analyses of the soil gas samples are reported in micrograms per liter ($\mu\text{g/l}$) in Tables 3 through 5. Although "micrograms per liter" is equivalent to "parts per billion (v/v)" in water analyses, they are not equivalent in gas analyses, due to the difference in the mass of equal volumes of water and gas matrices.

For QA/QC purposes, a duplicate analysis was performed on

every tenth field sample. Laboratory blanks of nitrogen gas (99.999%) were also analyzed after every tenth field sample.

Quality Assurance Samples

All laboratory blanks were free of detectable levels of the standardized analytes.

All Field Control Samples contained tetrachloroethene (PCE) ranging from 0.08 to 4.0 $\mu\text{g}/\text{l}$, indicating persistent carryover in the sampling equipment. The PCE observed in the field samples (0.60 to 6.7 $\mu\text{g}/\text{l}$) may not accurately reflect conditions in the soil gas at the sampling locations. Unsuccessful attempts were made to remove the contamination from the sampling equipment. Instead of immediately outflushing the nitrogen drawn into the sampling system during the purging step, the nitrogen was allowed to set in the sampling box for 5 minutes prior to flushing. In addition, sampling boxes were evacuated for 1/2 hour at the end of each day.

Analyte concentrations in duplicate sample pairs were within acceptable limits.

TABLE 1
SAMPLING ORDER

JANUARY 15, 1991

<u>SITE 2 SAMPLE</u>
1*
2
3
4
5
6
7
8
9
10
11
12
13**

<u>SITE 1 SAMPLE</u>
1
2
3
4
5***

JANUARY 16, 1991

<u>SITE 1 SAMPLE</u>
6*
7
8
9
10
11
12
13**

<u>SITE 2 SAMPLE</u>
14
15***

JANUARY 17, 1991

<u>SITE 4 SAMPLE</u>
1*
2
3
4
5
6
7
8**

<u>SITE 1 SAMPLE</u>
14
15
16
17
18***

* Beginning of Day, Field Control Sample
 ** Field Control Sample
 ***End of Day, Field Control Sample

TABLE 2

SAMPLING DEPTH SITE 1

<u>SAMPLE</u>	<u>FEET</u>
1	10
2	9
3	10
4	10
7	10
8	10
9	10
10	10
11	7
12	7
14	10
15	4
16	4
17	4

SAMPLING DEPTH SITE 2

<u>SAMPLE</u>	<u>FEET</u>
2	10
3	10
4	10
5	10
6	10
7	9
8	10
9	10
10	9
11	9
12	10
14	10

SAMPLING DEPTH SITE 4

<u>SAMPLE</u>	<u>FEET</u>
2	2
3	2
4	4
5	3
6	2
7	2

TABLE 3

*LABORATORY RESULTS FOR SITE 1
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL, XYLENE VOLATILES ¹	11DCE	111TCA	PCE
1	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<1.0	<0.10	6.0
2	1.3	<1.0	<1.0	<1.0	<1.0	12	<1.0	<0.10	5.2
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<0.10	6.0
4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.2	<0.10	4.2
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.62
8	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	<0.10	6.7
9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	5.7
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.1
11	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.6
12	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.1
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.8
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.8
16	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.75
17	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.83

* BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene

111TCA = 1,1,1-trichloroethane

PCE = tetrachloroethene

¹ CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 3 (cont)

*LABORATORY RESULTS FOR SITE 1
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL VOLATILES ¹	11DCE	111TCA	PCE
<u>FIELD CONTROL SAMPLES</u>									
5	<1.0	<1.0	<1.0	<1.0	<1.0	7.7	<1.0	<0.10	0.42
6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.08
13	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.11
18	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.38
<u>LABORATORY DUPLICATE ANALYSES</u>									
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.8
15R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.9
<u>LABORATORY BLANKS</u>									
BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene

111TCA = 1,1,1-trichloroethane

PCE = tetrachloroethene

¹CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 4

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL, XYLENE VOLATILES ¹	11DC	111TCA	PCE
2	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	1.3	<0.10	5.6
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<0.10	4.5
4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.7	<0.10	3.2
5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.6	<0.10	4.0
6	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	1.2	<0.10	1.9
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<0.10	2.1
8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<0.10	1.5
9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.6
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
11	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	3.3
12	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<0.10	2.6
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.7

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DC = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

¹ CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 4 (cont)

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL XYLENE VOLATILES ¹	11DCE	111TCA	PCE
FIELD CONTROL SAMPLES									
1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.0
13	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.45
LABORATORY DUPLICATE ANALYSES									
10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
10R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.4
14	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.7
14R	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	2.5

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

¹CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 4 (cont)

*LABORATORY RESULTS FOR SITE 2
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL, XYLENE VOLATILES ¹	11DCE	111TCA	PCE
<u>LABORATORY BLANKS</u>									
BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05
BCITP-2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05

* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

¹CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

TABLE 5

*LABORATORY RESULTS FOR SITE 4
CONCENTRATIONS IN MICROGRAMS PER LITER

SAMPLE	BENZENE	TOLUENE	ETHYL- BENZENE	m- & p- XYLENE	o- XYLENE	FID TOTAL, XYLENE VOLATILES ¹	11DCE	111TCA	PCE
2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	4.2
3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
4	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<0.10	0.60
5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.3
6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	1.9
7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.75

FIELD CONTROL SAMPLES

1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.46
8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	0.17

LABORATORY BLANKS

BCITP-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.10	<0.05
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* = BTEX WERE ANALYZED VIA GC/FID AND HALOCARBONS WERE ANALYZED VIA GC/ECD.

11DCE = 1,1-dichloroethene
111TCA = 1,1,1-trichloroethane
PCE = tetrachloroethene

¹CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM
PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

APPENDIX E
SOIL BORING LOGS

BORING LOG		BORING/WELL NO.: SKY PIEZOMETER #1 (PS-1)		REV. DATE: MAY 1990
Installation: SKY HAZWOP ANG		Site: 1 RT 1/14/91		Page 1 of 1
Project No.: 40721.02.06		Client/Project: HAZWRAP / SKY HAZWOP ANG		
HAZWRAP Contractor: IT Corporation		Drig Contractor: LAYNE ENVIRONMENTAL		
Drig Started: 1/15/91 (0750 AM)		Drig Ended: 1/15/91 (1335 AM)		Borehole dia(s): 9 3/4"
Drig Method/Rig Type: AIR Hammer Casing				
Logged by: GARDNER		E-Log (Y/N) From _____ to _____		Protection Level: D (MODIFIED)

Depth (ft)	Sample No	Sample Lab	Anal (Y/N)	Recovery (%)	Lithologic Description	Mud/Loss	Blows/6 inch	Graphic Log	Well data	Water depth & Remarks	Elev (ft)	
0-9 ft					SPAND. ^{RED} Brown, med. grained at top; transition to ^{WHITE} sand. 1 ft. contains w/ sand. 7 ft. - 6 ft. w/ sand.	10R					1120.08	
9-19 ft					SAND. Brown, med. grained; Gravel of some sand at ~ 16 ft.	3/3	SP					
							GP					
19-29 ft					SAND - Brown, med. grained, med. to coarse grained. Some gravel at 25 & 26 ft. Same as above, etc.	25R	GP					
						4/4	GP					
29-34 ft					Same. Note: At ~ 34 ft Dark Brown DRIFT MATERIALS SAND out of Casing.		SP					
					HA - Rhythmic 5 ft. at top. Drifted. Casing NO Rhythmic. (Shattering 2 ft. 0).							
34-49 ft					Same as above. Back to DRY SAND.		SP					
49-59 ft					Same as above. (No 10 ft. findings).							
					DRY, NO 10 ft. findings. (No 10 ft. findings).		GP					
59-70 ft					DRY, NO 10 ft. findings. (No 10 ft. findings).	2.5						
					DRY, NO 10 ft. findings. (No 10 ft. findings).	4R	SP					
70-80 ft					Wet. HIT WATER ca. 73-74 ft. Brown sand, poorly sorted, coarse grained. Occasional gravel. One COBBLE LAYER at ca. 76 ft.	5/4				73-74 ft. WATER		
80-90 ft					Same as above. Some fine water.		GP					
							SP					
90-100 ft					Same as above.		SP					
					BORING DEPTH ~ 100.5 ft.							
<p>NOTE: NO SAMPLER IN USE; OBSERVATIONS ARE FROM CUTTINGS AS COLLECTED AT THE CYCLONE. SOME STREAM DEPOSITS ARE NOTED, WHERE POSSIBLE.</p>												

U = Thin wall Tube	R = Rock Coring	Field G/C (Make/Mod.)
S = Split spoon (tube)	O = Other	G/C Oper.:
C = Cuttings	Notes: NO SAMPLER IN USE	

BORING LOG	BORING/WELL NO.: PS-2	Page 1 of 1
Installation: Sky Harbor ANG	Site:	
Project No. 401321-02-01	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drill Contractor: LARSEN ENVIRONMENTAL Driller: DAVID PETERSON	
Drill Started: 10/1/85 (2 m)	Drill Ended: 1/16/91 (10.15 m)	Borehole dia(s): 9 3/4 inches
Drill Method/Rig Type: Air Hammer Casing		
Logged by: GARDNER	E-Log (Y/N) (N)	From _____ to _____
Protection Level: D (non-rad)		

Depth (ft)	Sample No	Sample Lab	Recovery (Y/N)	Lithologic Description	Muswell Curve USCS	Blows/6 inch	Graphic Log	Well Data	Water Depth & Remains	Elevation
0				0-10 ft: SAND, DAMP, POORLY SORTED, medium to coarse grained. COBBLES at 6 ft. LT. BROWN	SP					114.16
10				10-20 ft: (COBBLES at 15 ft, 18 ft.)	GP					
20				SAME	SP					
20				20-30 ft: (COBBLES at 21 ft). SAND, POORLY SORTED, coarse to very coarse. Some large clastic gravel. 13 down	SP					
40				30-40 ft: SAND AS 20-30 ft. except some gravel & COBBLES & is very angular	GP					
40				40-50 ft: SAND, very coarse grained	SP					
60				DARK BROWN, angular, poorly sorted. Gravel, occasional COBBLES	GP					
60				50-60 ft: SAND, POORLY SORTED very coarse	SP					
60				Gravel SAND to small gravel. Occasional small COBBLES. DAMP. DARK BROWN	GP					
80				60-70 ft: SAND AS ABOVE, except NO small angular gravel DAMP (water)	GP					
80				70-80 ft: SAND AS 60-70 ft. DAMP to wet (Water c. 75')	GP				Water at approx 75'	
100				80-90 ft: SAND to ca. 88 ft 88-90 ft: MOSTLY GRAVEL & COBBLES w/ FINE to MEDIUM GRAINED SILTY SANDS stick to them. Sticky, wet, DARK BROWN	GP					
100				90-100 ft: Blow water. SAND AS 80-90 ft section coarse gravel & sand w/ silt.	GP					
BOREHOLE DEPTH = N 100' 8"										
NOTE: NO SAMPLER IN USE; OBSERVATIONS ARE FROM CUTTINGS AS COLLECTED AT THE CYCLONE. SOME SPECIFIC DEPTHS ARE NOTED, NUMBER POSSIBLE.										
U = Thin Wall Tube R = Rock Coring NA Field G/C (Make/Mod.) NA S = Split spoon (tube) O = Other NA G/C Oper.: NA C = Cuttings Notes: No sampler in use										

BORING LOG		BORING/WELL NO.: PS-3		REV. DATE MAY 1990	
Installation: Sky Harbor ANG Base		Site:		Page 1 of 1	
Project No.: 40972-02-06		Client/Project: HAZWRAP/Sky Harbor ANG			
HAZWRAP Contractor: IT Corporation		Drig Contractor: Lane Environmental		Driller: Dwight Peterson	
Drig Started: 1/16/91 (12.55 P.M.)		Drig Ended: 1/17/91 (9.10 A.M.)		Borehole dia(s): 9 3/4 inches	
Drig Method/Rig Type: Air Percussion Hammer					
Logged by: GARDNER		E-Log (Y / <input checked="" type="radio"/>)		From _____ to _____ Protection Level: D (MODIFIED)	

Depth (ft)	Sample No	Sample Lab Anal. (Y/N)	Recovery	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	Elev.
0-10 ft				SAND; medium grained, mostly well sorted (SYR HUE 4/3), reddish brown. Sub rounded to slightly angular.	SP						1114.13
10-20 ft				SAND; Gravel at ~ 18 ft coarse less red (4.5 SYR; 5/4) - red brown	SP						
20-30 ft				SAND, moderately sorted, light brown (7.5 SYR 6/4) small gravel at 29 ft & small cobbles at 30 ft; sub angular	SP						
30-40 ft				SAND; medium grained (7.5 SYR 6/3); large to small angular gravel & small rounded cobbles.	SP GP						
40-50 ft				SAND (drain from 46 and drain) same as 30-40 sample	SP GP						
50-60 ft				SAND; medium to coarse grained, poorly sorted, angular to sub angular; angular gravel & rounded cobbles; drain? (7.5 SYR 4/3)	SP						
60-70 ft				SAND, same as before, drain (7.5 SYR 3/3) (dark brown)	SP						
70-80 ft				SAND same as 60-70 ft. drain to wet. Estimate water at 75 ft.							
80-90 ft				SAND, wet. (SYR 3/2) (when wet) coarse grained, poorly sorted, medium to sub ang.; rounded gravel & cobbles making water at 93 ft.	SP GP						
90-100 ft				SAND, gravel, water. Large cobbles coarse to medium sand. Rounded gravel & cobbles, sub angular sand	GP						

STRT 100
JET 200

U = Thin Wall Tube R = Rock Coring NA Field G/C (Make/Mod.) NA
S = Split spoon (tube) O = Other NA G/C Oper.: NA
C = Cuttings Notes:

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. MWS-01	Page 1 of 3
Installation: Sky Harbor	Coordinates:	Site: Sky Harbor Back Bay
Project No. 40922.02.06	Client/Project: HAZWRAP/Sky Harbor ANJ	
HAZWRAP Contractor: ITC	Drill Contractor: LAYNE Engineering	Driller: DEARY LODGE
Drill Started: 1/24/91 (17:40 P.M.)	Drill Ended: 1/30/91 (11:45 A.M.)	Borehole dia(s): 9 3/4"
Drill Method/Rig Type: Air Hammer Case		
Logged by: GARDINER	E-Log (Y/N) (N)	From _____ to _____
		Protection Level D (MODIFIED)

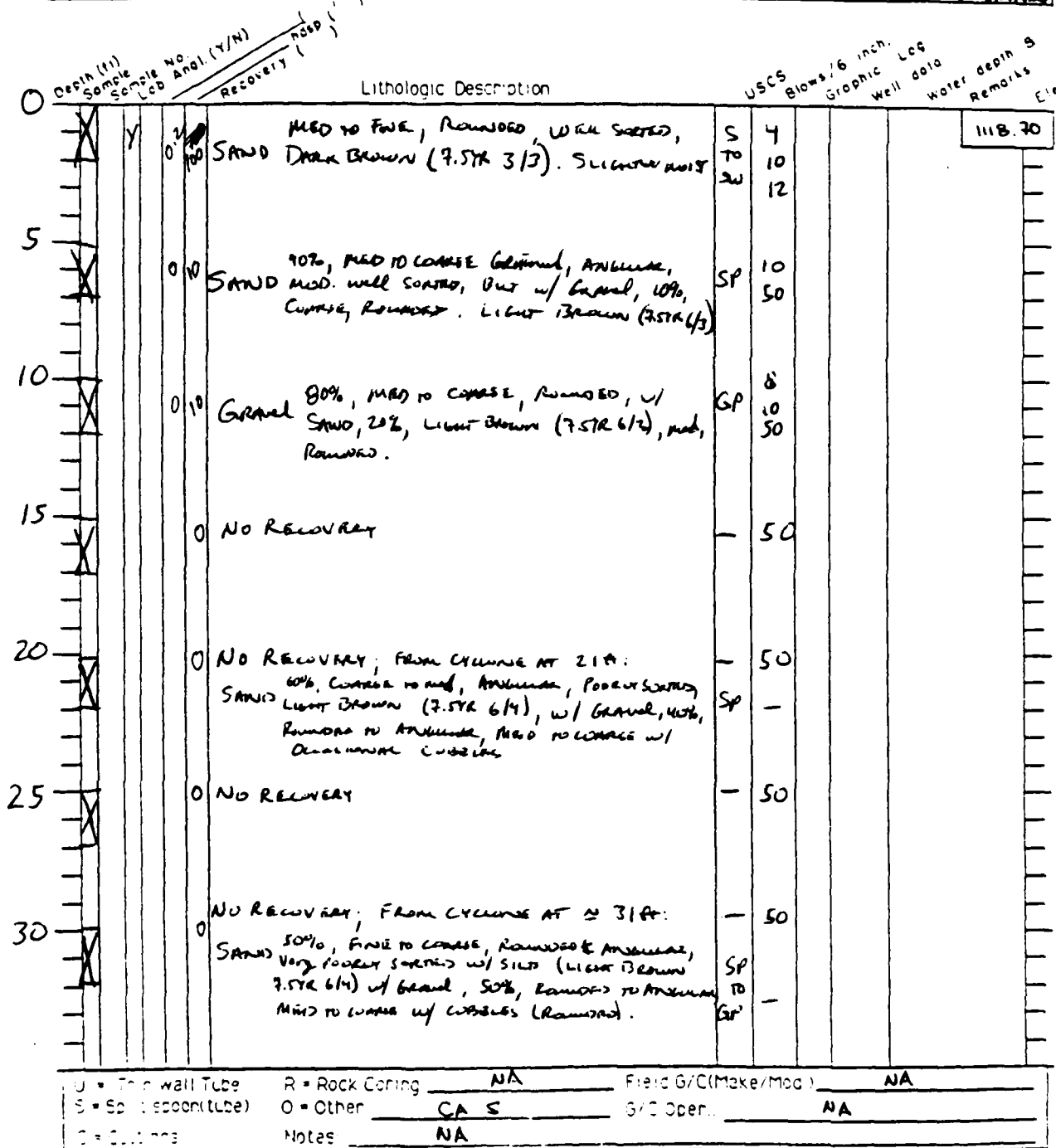


FIGURE 5-3a

REV. DATE: MAY 1990

BORING LOG	BORING/WELL NO.: <u>MWS-01</u>	Page <u>2</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>Sky Harbor Break Ground Work</u>
Project No.: <u>408721.02.06</u>	Client/Project: <u>HAZWRAP/Sky Harbor Area</u>	
HAZWRAP Contractor: <u>IT Corporation</u>	Drill Contractor: <u>LAYNE ENVIRONMENTAL</u>	Driller: <u>DEERY LADDER</u>
Drill Started: <u>1/21/91</u> (<u>12:00</u> <u>PM</u>)	Drill Ended: <u>1/30/91</u> (<u>11:45</u> <u>PM</u>)	Borehole dia(s): <u>9 3/4"</u>
Drill Method/Rig Type: <u>Air Hammer Casing</u>		
Logged by: <u>GARDNER</u>	E-Log (Y/N) <u>(N)</u>	From <u> </u> to <u> </u>
		Protection Level <u>D</u> (MODIFIED)

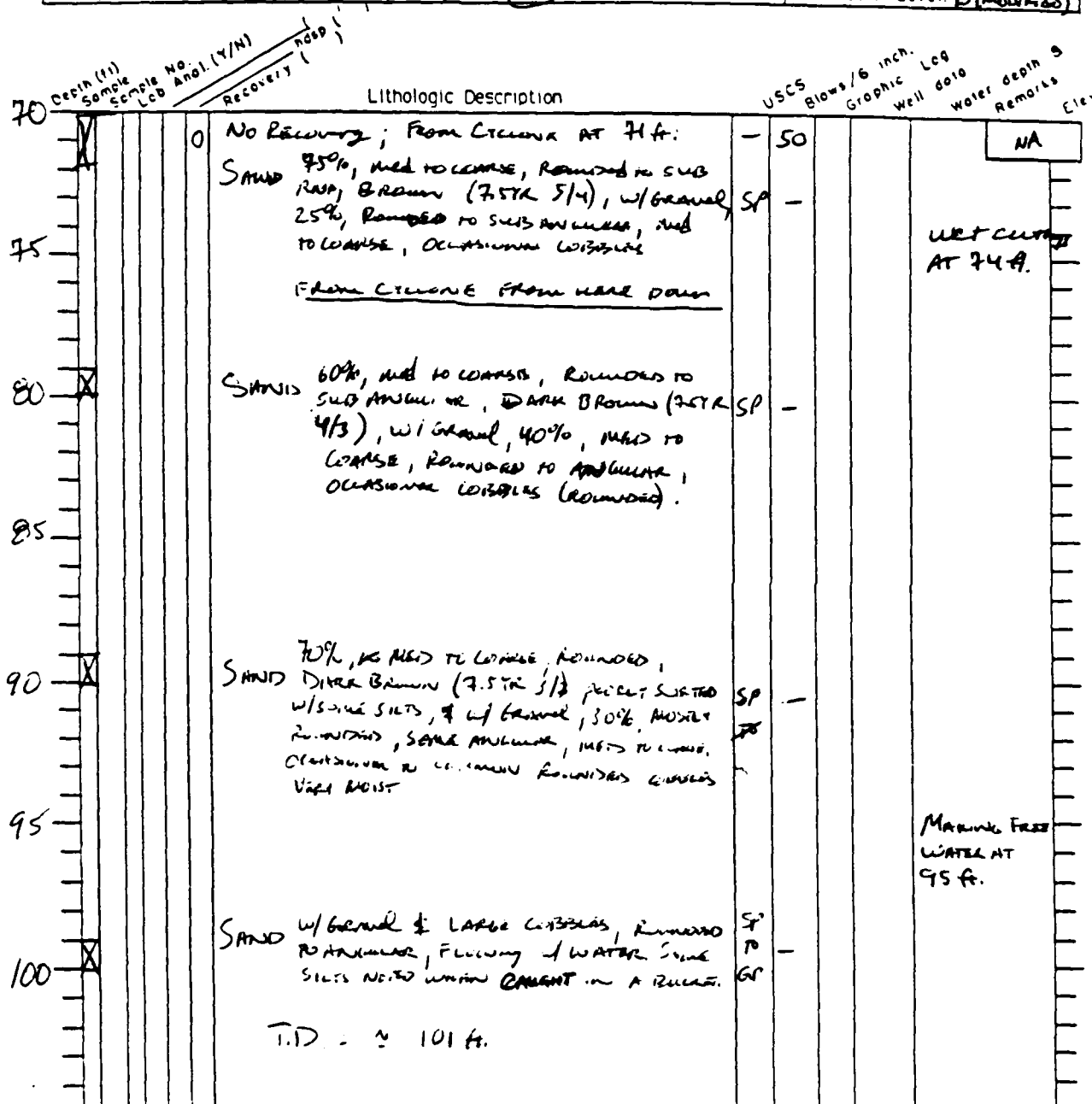
Depth (ft)	Sample No.	Sample Lab	Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth	Remarks	Elev.
35					0 NO RECOVERY		50				NA	
40					0 NO RECOVERY; FROM CYCLONE AT ≈ 41 ft. SANDS 70%, MED TO COARSE, ROUNDED TO SUB-ANG, MED. BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, 30%, MOSTLY ROUNDED TO SUB ROUNDED, MED. VERY SILTY AND MOIST	SP	50					
45					0 NO RECOVERY		50					
50					0 NO RECOVERY; FROM CYCLONE AT ≈ 51 ft. SANDS 70%, MED, ROUNDED TO SUB ROUNDED BROWN (7.5YR 5/3), POORLY SORTED w/ GRAVEL, MED TO COARSE, ROUNDED & ANGLULAR w/ OCCASIONAL CUBICLES (ROUNDED)	SP	50					
55					0 NO RECOVERY		50					
60					2 SAND 60% w/ SOME SILT, MED, ROUNDED, DARK BROWN (7.5YR 3/3), POORLY SORTED w/ GRAVEL, 40% w/ SOME SILT, MED TO COARSE, ROUNDED VERY MOIST	SP TO SM	50 22 22 25					
65					0 NO RECOVERY		50					

U = Thin wall Tube	R = Rock Coring	Field G/C (Make/Mod.)
S = Split spoon (tube)	O = Other	G/C Oper:
C = Castings	Notes:	

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: MLWS-01	Page 3 of 3
Installation: Sky Harbor	Coordinates:	Site: Sky Harbor Background Well
Project No.: 401321.07.06	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drig Contractor: LANE ENVIRONMENTAL	Driller: Davey Linder
Drig Started: 1/26/91 03:00 (2 m)	Drig Ended: 1/30/91 (11:45 A m)	Borehole dia(s): 9 3/4"
Drig Method/Rig Type: Air Hammer Casing		
Logged by: GARDINER	E-Log (Y/N) (N)	From _____ to _____
		Protection Level: D (MODIFIED)



U = Thin wall Tube	R = Rock Coring	NA	Field G/C (Make/Mod.)	NA
S = Split spoon (tube)	O = Other	CA S	G/C Oper:	NA
C = Closures	Notes:	NA		

FIGURE S-3 a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: MWS-02	Page 1 of 3
Installation Sky Harbor	Coordinates:	Site Sky Harbor, Bannockburn, IL
Project No. 401921-01-01	Client/Project: HAZWAP / LITIGATION Sky Harbor, AN36	
HAZWAP Contractor: IT Corporation	Drig Contractor: LANE Environmental	Driller: DEAN LUDERS
Drig Started 1/31/91 (14:15 P.M.)	Drig Ended: 2/6/91 40:00 AM	Borehole dia(s) 9 3/4"
Drig Method/Rig Type: Air Hammer Coring		
Logged by: GARDNER	E-Log (Y/N) (N)	From _____ to _____
Protection Level D (Modified)		

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
0				75%, MED to coarse, rounded to SAND SUB ROUNDED, POORLY SORTED w/ GRAVEL, 25%, rounded, med to coarse. Some angular pebbles. (2.5YR 5/4)	SP	16				1115.91
5				50%, med to coarse, rounded, mixed w/ angular & concrete fill. Many pebble fill.	SP	22				
10				90%, MED to FINE, rounded to SAND SUB ROUNDED, mostly well sorted, but w/ occasional gravel, 10%, rounded, med. (7.5YR 5/4)	SP	26				
15				80%, med to coarse, angular, poorly sorted w/ gravel, 20%, med to fine, rounded. (2.5YR 7/4)	SP	10				
20				No Recovery	SP	15				
25				(20% Recovery)	SP	20				
30				55%, very coarse, angular, poorly sorted w/ gravel 45%, rounded to SAND SUB ROUNDED, med. Slightly moist, brown (7.5YR 5/4).	SP	50				
				No Recovery	SP	50				

U = Thin wall Tube	R = Rock Coring	NA	Field G/C (Maker/Mod.)	NA
S = Split spoon (tube)	O = Other	CAS	G/C Oper.:	NA
C = Castings	Notes:	NA		

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: MWS-02	Page 2 of 3
Installation Sky Harbor	Coordinates:	Site: Sky Harbor, Bunker 4, 4288
Project No. 70721.01.06	Client/Project: HAZWOP / Sky Harbor ANG	
HAZWOP Contractor: IT Corporation	Drill Contractor: LAYNE ENVIRONMENTAL	Driller: Denny L. Linder
Drill Started 11/31/91 (14:15 m)	Drill Ended: 2/6/91 (10:00 A m)	Borehole dia(s) 9 3/4"
Drill Method/Rig Type: Air Hammer Casing		
Logged by: GARDINER	E-Log (Y/N) (Y)	From _____ to _____ Protection Level D (MODIFIED)

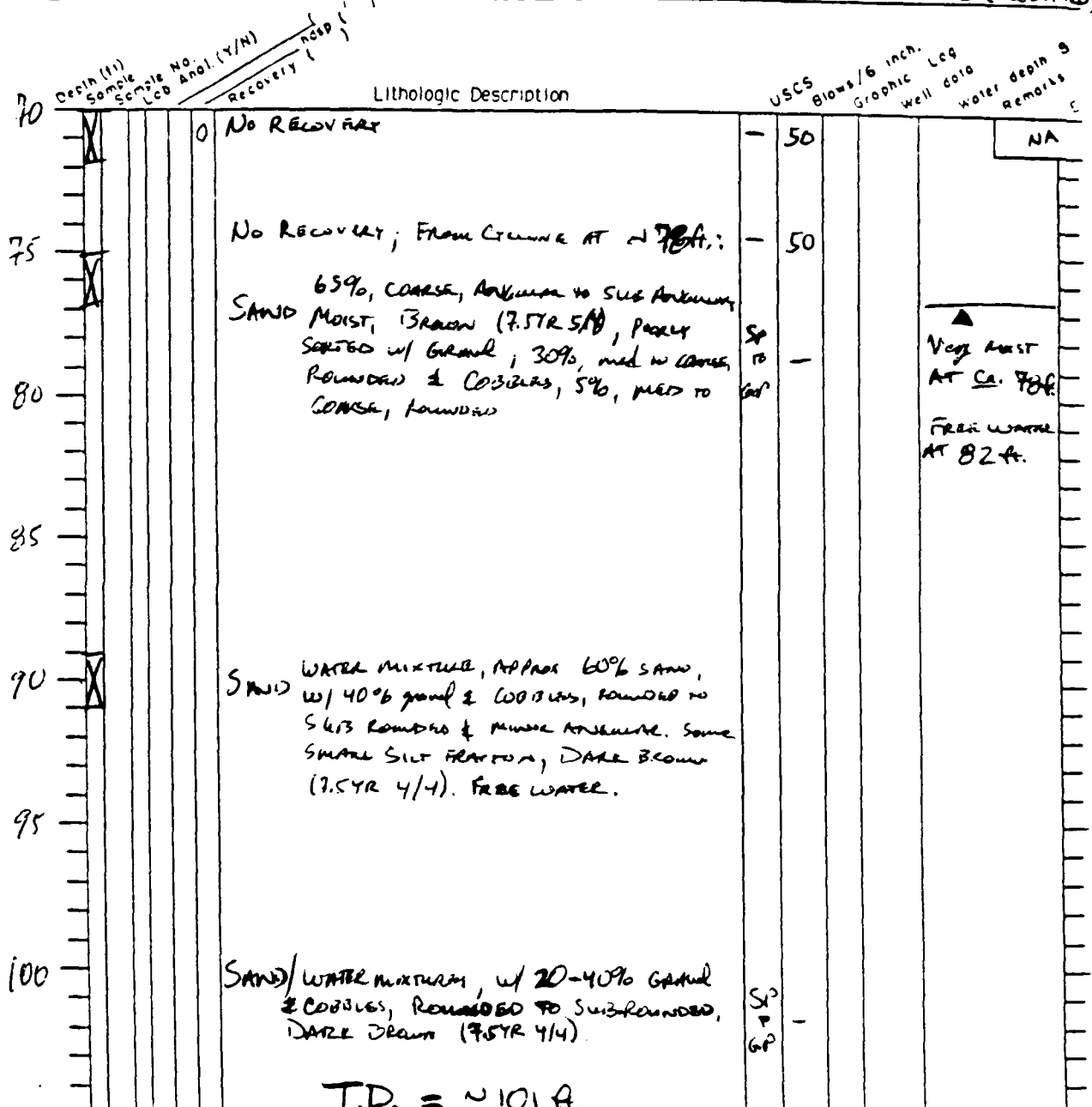
Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	X		0	NO RECOVERY	-	50				NA
40	X		0	SAND 70%, mostly rounded, med to coarse, poorly sorted, brown (7.5YR 5/4) w/ gravel, 30%, med to coarse, mostly rounded to sub rounded w/ rare rounded cobbles	SP	50				
45	X		0	SAND 80%, mostly rounded, med. to coarse, brown (7.5YR 5/4), poorly sorted w/ some silt or silt clay 5%, brown (7.5YR 5/4), moist, & w/ gravel, 30%, rounded, med.	SP TO SM	50				
50	X		0	SAND 70%, med to coarse, rounded to sub ang, brown (7.5YR 5/4), moist, poorly sorted w/ some silt/clay (brown & moist) & gravel, med, rounded (30%).	SP TO SM	50				
55	X		0	NO RECOVERY	-	50				
60	X		0	NO RECOVERY; From 57 cm to 61 ft: 60% med, rounded to sub rnd, brown SAND (7.5YR 5/4), moist, w/ gravel 40%, med to coarse, rounded w/ occasional cobbles.	SP	-				
65	X		0	NO RECOVERY	-	50				

U = Thin Wall Tube	R = Rock Coring	NA	Field G/C (Make/Mod.)	NA
S = Split Spoon (tube)	O = Other	CAS	G/C Oper.:	NA
C = Casing	Notes:	NA		

FIGURE 5-3a

REV DATE MAY 1997

BORING LOG	BORING/WELL NO.: MWJ-02	Page 3 of 3
Installation Sky Harbor	Coordinates:	Site: Sky Harbor Background Well
Project No. 401721-02-04	Client/Project: HAWAIIAN / Ely HAWAIIAN AVE	
HAWAIIAN Contractor IT Corporation	Drill Contractor: LANE ENVIRONMENTAL	Driller: DERRY LUDGER
Drill Started 1/21/01 (14:15 P.M.)	Drill Ended 2/6/01 (10:00 A.M.)	Borehole dia(s) 9 3/4"
Drill Method/Rig Type: AIR Hammer Casing		
Logged by: GARDNER	E-Log (Y/N) ()	From _____ to _____
		Protection Level D (Modified)



T.D. = ~101 ft.

U = Thin wall Tube	R = Rock Coring	NA	Field G/C (Make/Mod)	NA
S = Split spoon (tube)	O = Other	CA S	G/C Oper.:	NA
C = Casing	Notes:	NA		

FIGURE 5-3a

REV DATE MAY 1991

TESTING LOG	BORING WELL NO	MWS-03	Page	1	of	3	
Installation	Sky Harbor	Coordinates:	Site Sky Harbor, Bunker Hill				
Project No	401726006	Client/Project	HAWAIIAN / Sky Harbor Airfield				
Drilled Contractor	ITW-ARCON	Drill Contractor	WATER BIRMINGHAM	Driller	JERRY LUDWIG		
Drill Started	11/30/91	(13:30 P.M.)	Drill Ended	11/31/91	(13:20 P.M.)	Borehole dia(s)	9 1/4"
Drill Method/Rig Type	Air Hammer Casing						
Used by	WALDINGA	E-Log (Y/N)	(Y)	From	to	Protection Level	D (MODIFIED)

Depth (ft)	Sample No	Recovery (%)	Lithologic Description	USCS	Grain Size	Log	Water Depth	Remarks
0	016		95% med, rounded to sub round, sand. Dark brown (7.5R 4/3), mostly well sorted w/ occasional gravel, 5% med, rounded, med to fine.	SW	20			1116.14
5	017		75% med, round to angular, dark gray (7.5R 4/3), poorly sorted w/ gravel, 25% med, rounded. Piece of concrete in top 4 inches.	SP	6			
10			CONCRETE		4			
15			NO RECOVERY, CONCRETE RUBBLE		50			
20			NO RECOVERY, FROM CHAIN AT 21 ft:		50			
25			60% very coarse, angular, light sand. Dark (7.5R 5/4 to 6/4), poorly sorted w/ some fines & gravel, 40% fine to coarse & occasional cobbles, rounded.	SP	6			
30			NO RECOVERY		50			
35			NO RECOVERY, FROM CHAIN AT 31 ft:		50			
40			55% coarse, angular, light brown (7.5R 6/4), poorly sorted w/ gravel, 40% rounded to angular, fine to coarse w/ cobbles, 5% rounded.	SP	6			

Test Well Type	R = Rock Coring	NA	Field 3: Move Mod	NA
Test Well (depth tube)	O = Other	CA S	Field 3: Open	NA
Test Well	Notes	NA		

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. MW5-03	Page 2 of 3
Installation Sky Harbor	Coordinates:	Site Sky Harbor, Borehole No. 1
Project No. 40826.04	Client/Project: HAZMAT / Sky Harbor Area	
HAZWOP Contractor ITC Environmental	Drill Contractor Lantz Environmental	Driller: D. [unclear]
Drill Started 1/30/91 (13 20 P.M.)	Drill Ended 1/31/91 (13 20 P.M.)	Borehole dia(s) 9 3/4"
Drill Method/Rig Type: Air Hammer (Casing)		
Logged by: [unclear]	E-Log: [unclear]	From [unclear] to [unclear] Protection Level: D (Medium)

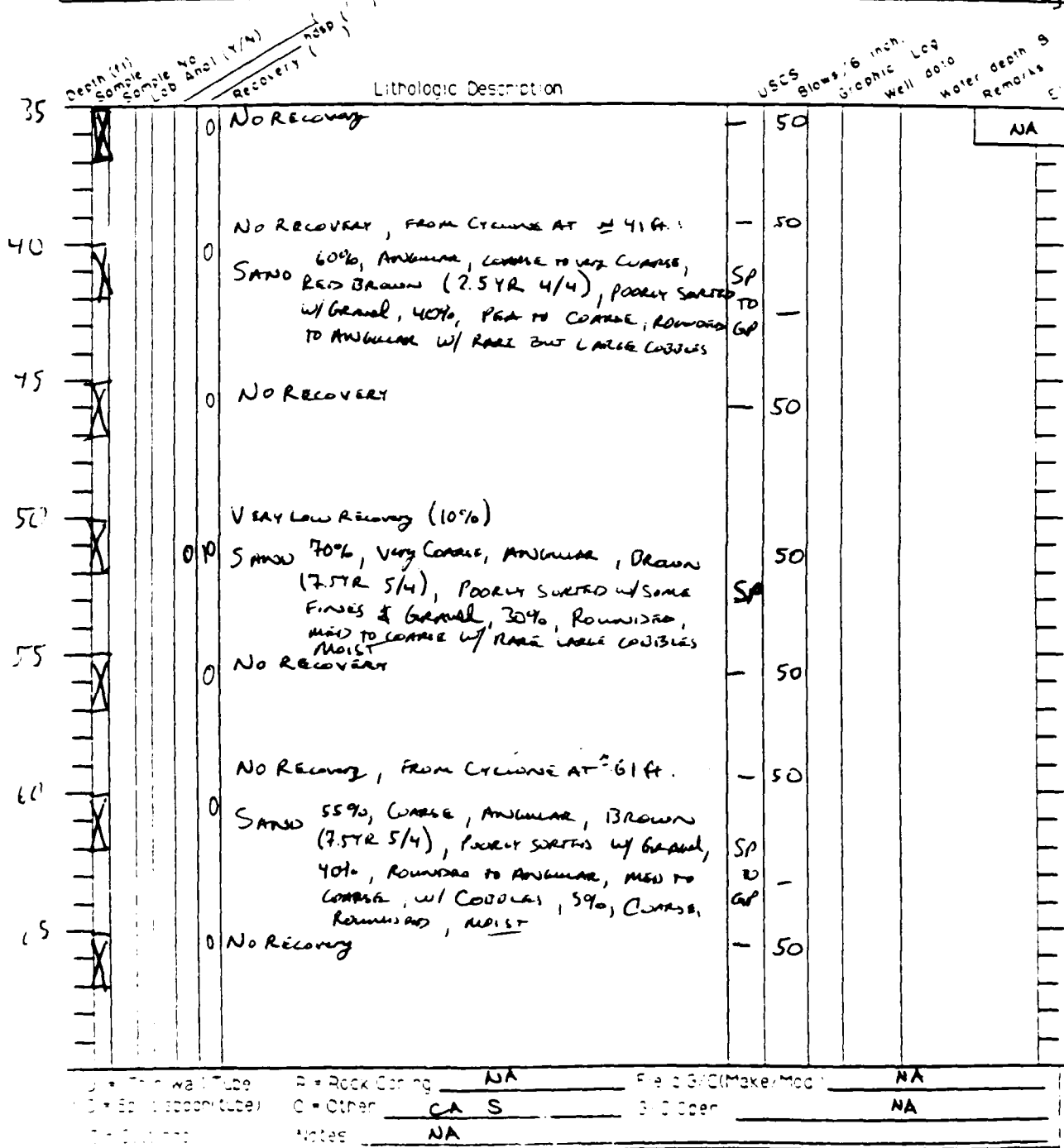


FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: <u>MWS-03</u>	Page <u>3</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>Sefton Harbor, Bismarck Harbor</u>
Project No.: <u>40121.000</u>	Client/Project: <u>Hikurangi / Set Hamur: Anis</u>	
Drilled Contractor: <u>ITC Corporation</u>	Drill Contractor: <u>Watan Engineering</u>	Driller: <u>Dean Loring</u>
Drill Started: <u>1/2/91</u> (13:32 Z m)	Drill Ended: <u>1/31/91</u> (13:20 Z m)	Borehole dia(s): <u>9 3/4"</u>
Drill Method/Rig Type: <u>Air Hammer / Core</u>		
Logged by: <u>W. D. V. L.</u>	E-Log (Y/N): <u>Y</u>	From <u> </u> to <u> </u>
		Protection Level: <u>D (moderate)</u>

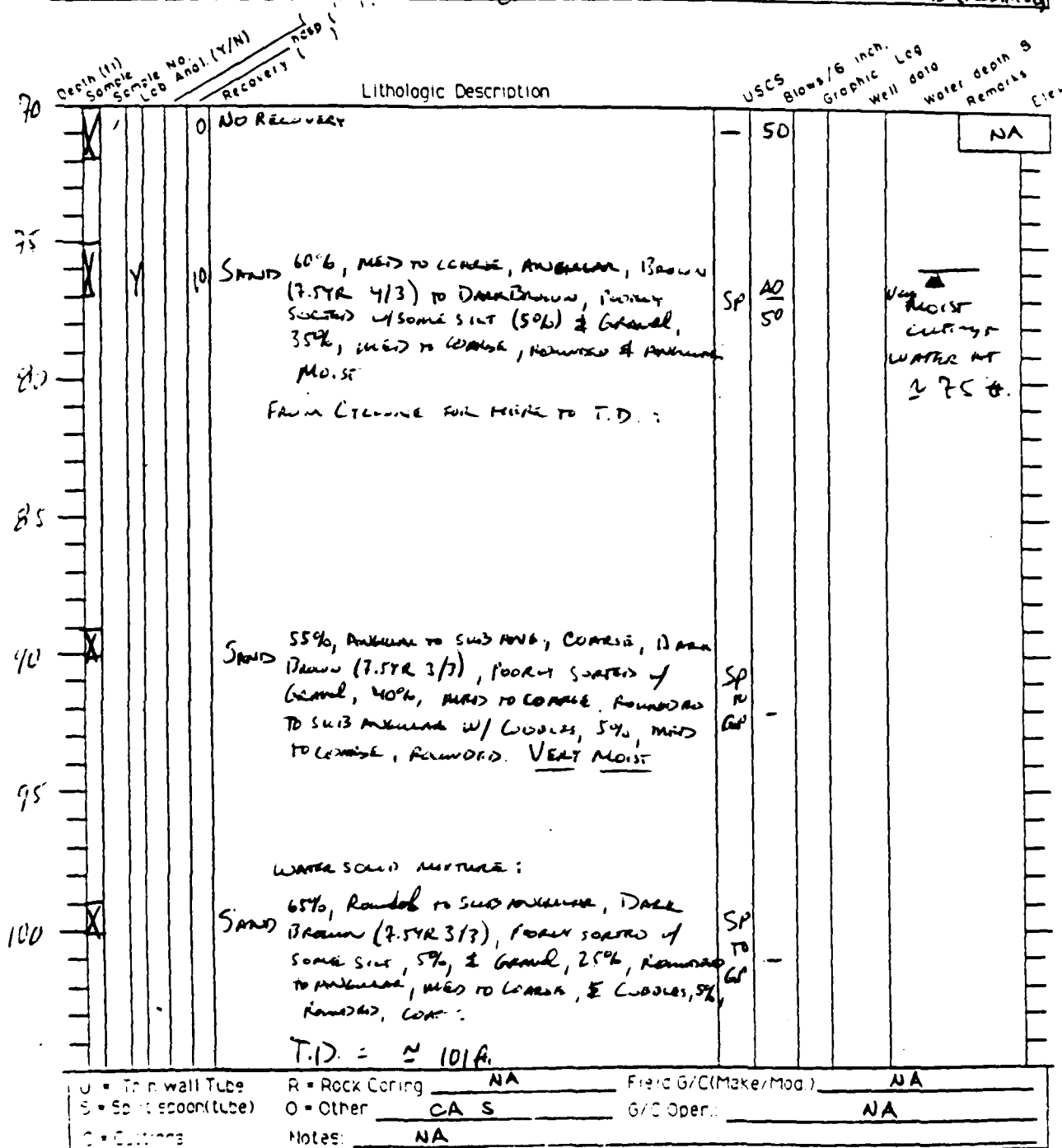
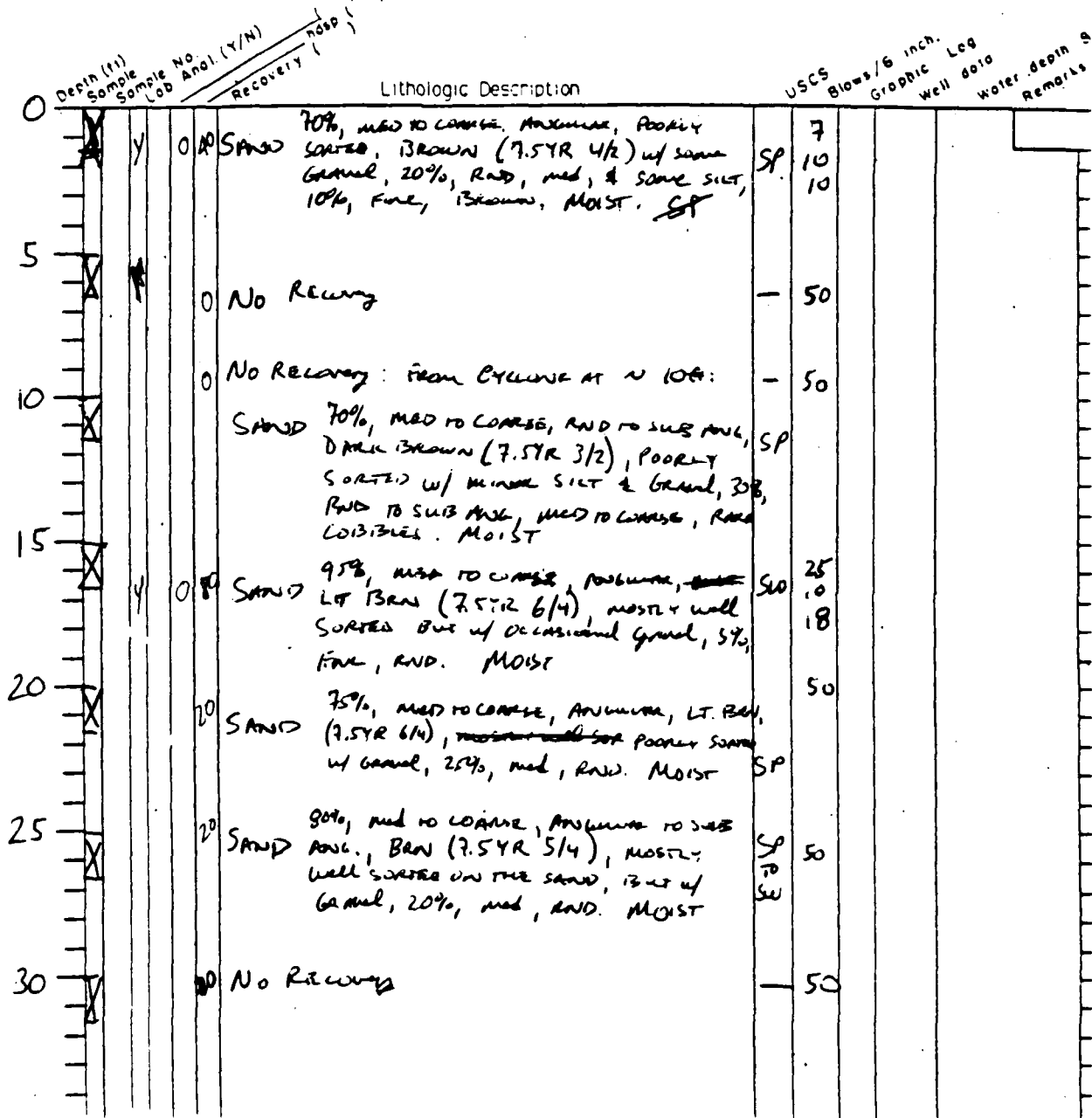


FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO. <u>ABS-04 MWS-04</u>	Page <u>1</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>SH BANCARD, WASH MWS-04</u>
Project No: <u>40131.012</u>	Client/Project: <u>HAZWRAP / Sky Harbor ANA Base</u>	
HAZWRAP Contractor: <u>IT Corporation</u>	Drig Contractor: <u>Lance Environmental</u>	Driller: <u>Duane Peterson</u>
Drig Started: <u>3/21/91</u> (9 45 A.m)	Drig Ended: <u>3/21/91</u> (4 30 P.m)	Borehole dia(s) <u>4 10 3/4"</u>
Drig Method/Rig Type: <u>Art Dm Tube Percussion</u>		
Logged by: <u>GARDINER</u>	E-Log (Y/N) <u>(N)</u> From <u> </u> to <u> </u>	Protection Level: <u>D (Mod. med)</u>



U = Thin wall Tube
S = Sp. (scoop) tube
C = Casing

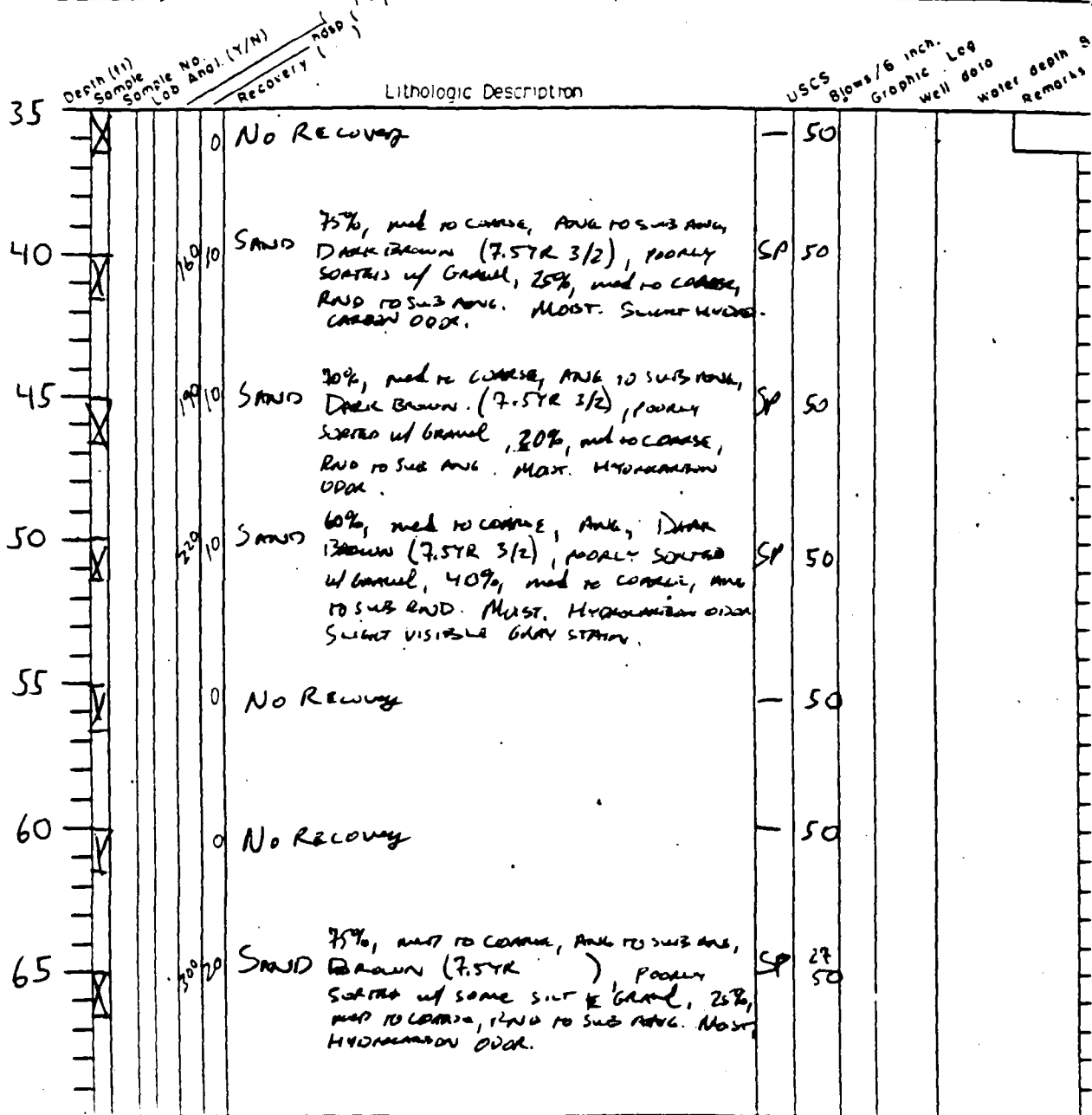
R = Rock Coring
O = Other
Notes

Field G/C (Make/Mod)
G/C Oper.

FIGURE 5-3a

REV. DATE MAY 199

BORING LOG	BORING/WELL NO. <u>MWS-04</u>	Page <u>2</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>SH BANGOR WASH MWS-04</u>
Project No.: <u>40921</u>	Client/Project: <u>HAZWRAP / SKY HARBOR ANG BASE</u>	
HAZWRAP Contractor: <u>IT Corporation</u>	Drill Contractor: <u>Layne Environmental</u>	Driller:
Drig Started: <u>3/1/91 (9:45 A.M.)</u>	Drig Ended: <u>3/1/91 (4:30 P.M.)</u>	Borehole dia(s): <u>N 10 3/4"</u>
Drig Method/Rig Type: <u>DUAL TUBE PERCUSSION</u>		
Logged by: <u>GARDNER</u>	E-Log (Y/N) <u>(N)</u>	From <u> </u> to <u> </u>
		Protection Level <u>D (MODIFIED)</u>



U = Thin wall Tube

R = Rock Coring

Field G/C (Make/Mod.)

S = Sp. (Spoon/Tube)

O = Other

G/C Oper.

C = Casing

Notes

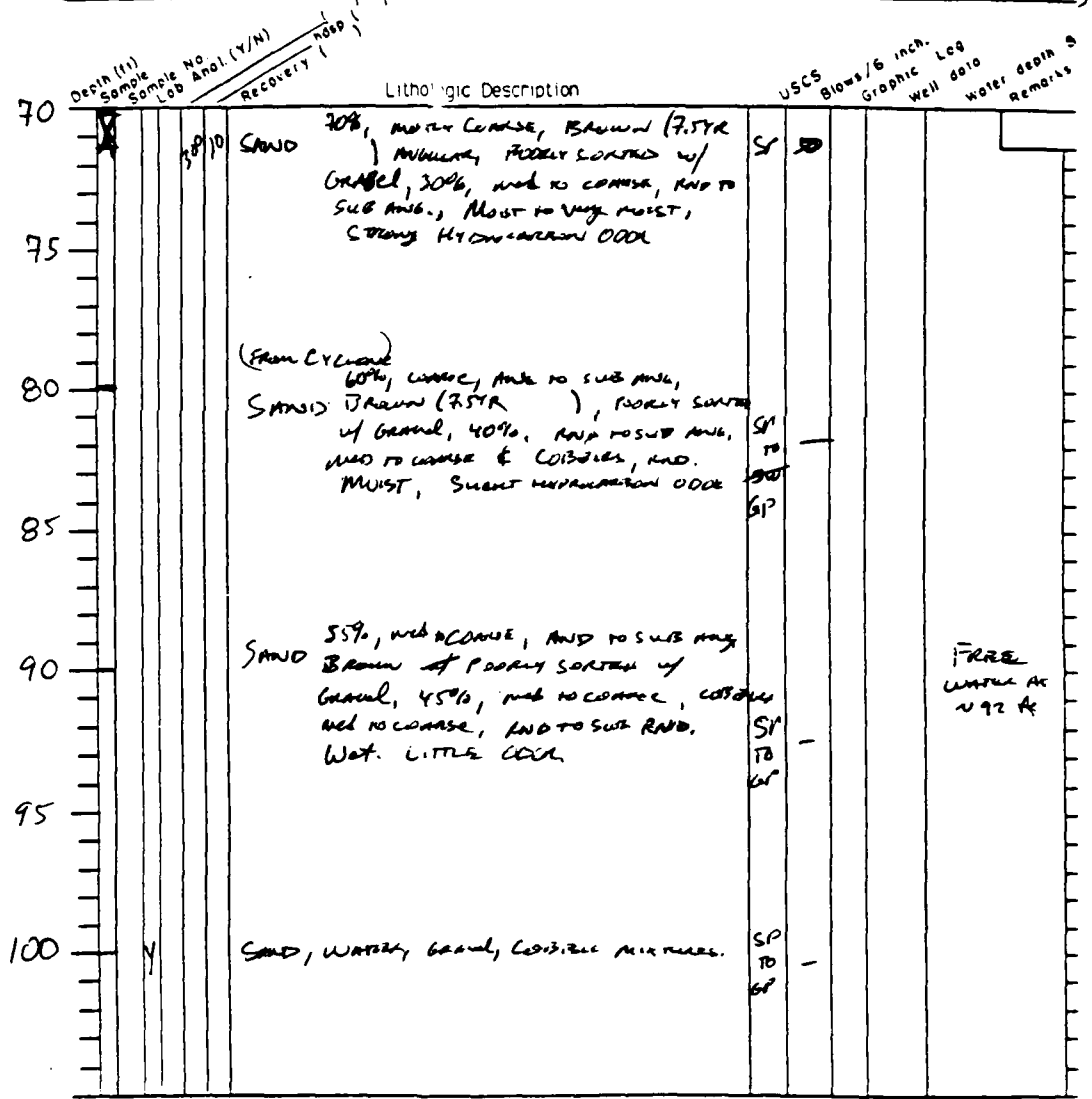
ARE NOTED, WHERE POSSIBLE.

U = Thin Wall Tube	R = Rock Coring	Field G/C (Make/Mod.)
S = Split spoon (tube)	O = Other	G/C Oper.:
C = Cuttings	Notes: <u>NO SAMPLES IN USE</u>	

FIGURE 5-3a

REV DATE MAY 199
Page 3 of 3

BORING LOG	BORING/WELL NO: <u>MWS-04</u>	Site: <u>SH Backcountry Well MWS-0</u>
Installation: <u>Sky Harbor</u>	Coordinates:	
Project No.: <u>40132</u>	Client/Project: <u>HAZWRAP/Sky Harbor Air Base</u>	
HAZWRAP Contractor: <u>IT Corporation</u>	Drig Contractor: <u>Lane Environmental</u>	Driller:
Drig Started: <u>3/21/91 (9:45 a.m.)</u>	Drig Ended: <u>3/21/91 (4:30 p.m.)</u>	Borehole dia(s): <u>~10 3/4"</u>
Drig Method/Rig Type: <u>Dual Tube Percussion</u>		
Logged by: <u>GARDINER</u>	E-Log (Y/N) <u>(N)</u>	From <u> </u> to <u> </u>
		Protection Level: <u>D (modified)</u>



U = Thin wall Tube	R = Rock Coring	Field G/C (Make/Mod.)
S = Split spoon (tube)	O = Other	G/C Oper.:
C = Cuttings	Notes:	

FIGURE 5-3a

REV DATE MAY 990

BORING LOG	BORING/WELL NO. <u>M011-02</u>	Page <u>1</u> of <u>2</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>7</u>
Project No. <u>404721.0200</u>	Client/Project: <u>HAWAII / Sky Harbor AKA</u>	
HAZWAP Contractor: <u>ITC</u>	Drill Contractor: <u>LARSEN Foundation</u>	Driller: <u>DEBBY L. OGDEN</u>
Drill Started: <u>01/28/01</u> (<u>08:45</u> a.m.)	Drill Ended: <u>1/28/01</u> (<u>15:00</u> p.m.)	Borehole dia(s): <u>9 3/4"</u>
Drill Method/Rig Type: <u>Air Hammer Casing</u>		
Logged by: <u>CARDINAL</u>	E-Log: <u>(Y/N)</u>	From <u> </u> to <u> </u>
		Protection Level: <u>D (Lowest)</u>

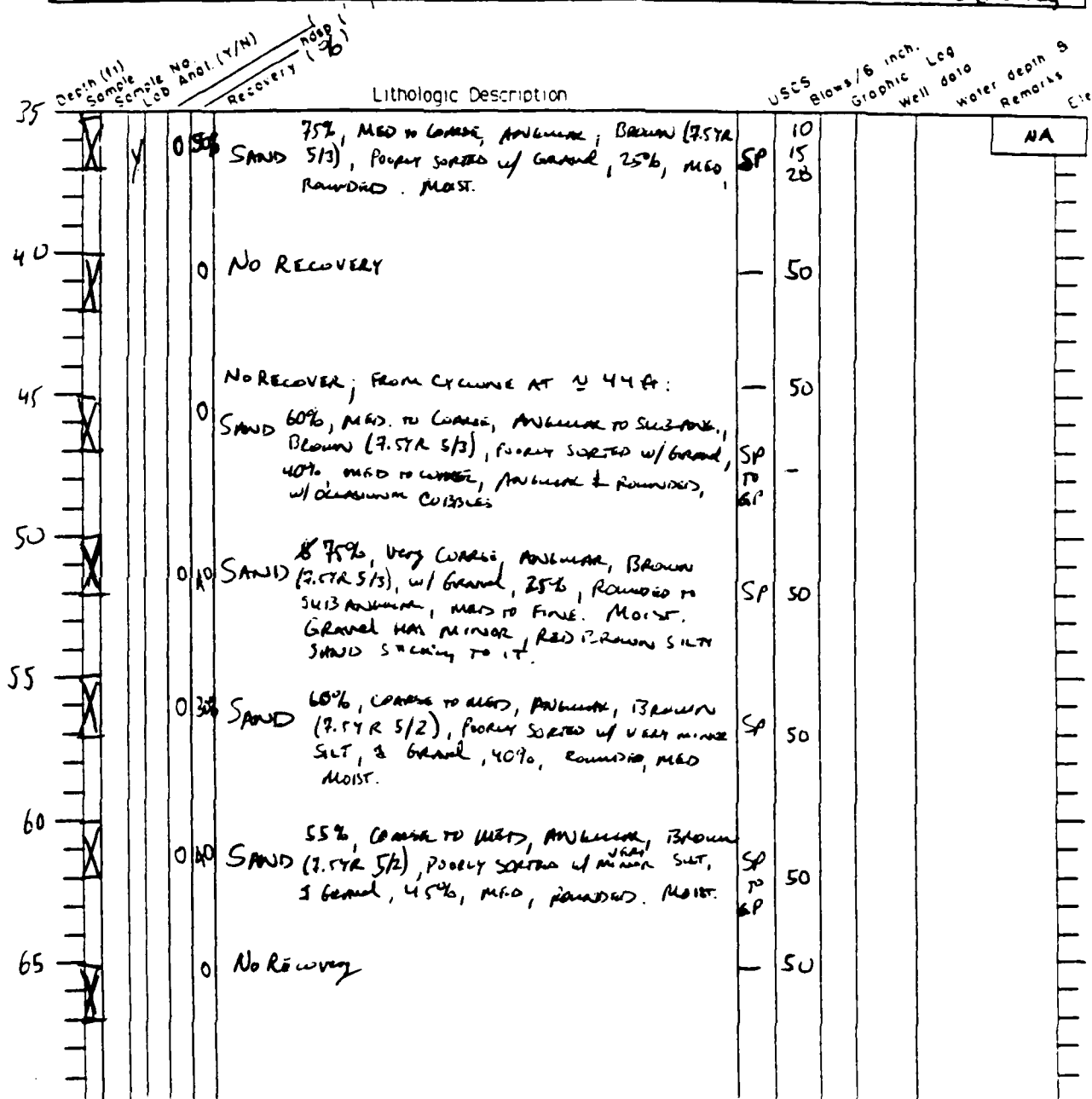
Depth (ft)	Sample No	Lab Anal (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	E'
0	X			Met to rise, Brown (7.5% 5/1), poorly sorted w/ occasional gravel (10%), met to fine, rounded, moist.	SP	12				1116.34	
5	X			No Recovery	-	50					
10	X			No Recovery. From Casing at 11 ft 70% fine, poorly sorted, met to coarse, brown (7.5% 5/3), w/ gravel (30%), met to coarse, rounded w/ occasional cobbles.	SP	50					
15	X			40% coarse, angular, brown (7.5% 5/3), well sorted but w/ gravel, 60%, rounded, moist.	SP	50					
20	X			No Recovery	-	50					
25	X			No Recovery. From Casing at \approx 28 ft.: 60% coarse, angular, brown (7.5% 5/3), poorly sorted w/ gravel, 40%, rounded w/ angular, met to coarse w/ occasional cobbles.	SP	50					
30	X			No Recovery	-	50					

U = Thin wall Tube	R = Rock Coring	Field G/C (Make/Model)
S = Split spoon tube	O = Other	G-C Oper
Notes		

FIGURE 5-3a

REV. DATE MAY 1990

BORING LOG	BORING/WELL NO. MW1-02	Page 2 of 3
Installation: Sky Harbor	Coordinates:	Site: 1
Project No: 407221.02.06	Client/Project: HAWAII / SK: Harbor Area	
HAWAII Contractor: IT Corporation	Drill Contractor: LARRY ENGINEERING	Driller: DAVE LUDDE
Drill Started: 1/28/91 08:45 A.M.	Drill Ended: 1/28/91 (K.O. P.M.)	Borehole dia(s): 9 1/4"
Drill Method/Rig Type: AIR Hammer Case		
Logged by: GARDNER	E-Log (Y/N): (N) From _____ to _____	Protection Level: D (Moist)



U = Thin wall Tube
S = Sp. spoon (tube)
C = Core

R = Rock Core
O = Other
Notes: NA

Field G/C (Make/Model): NA
G/C Oper: NA

FIGURE 5-3a

REV. DATE MAY 1990

BORING LOG	BORING/WELL NO.: <u>MM-02</u>	Page <u>3</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>Site 1</u>
Project No: <u>409221.02.01</u>	Client/Project: <u>HAZWAP / Sky Harbor ANG</u>	
HAZWAP Contractor: <u>IT Corporation</u>	Drig Contractor: <u>LATITE Environmental</u>	Driller: <u>DEAN LORING</u>
Drig Started: <u>1/25/91</u> (<u>08:45 A.M.</u>)	Drig Ended: <u>1/26/91</u> (<u>15:00 P.M.</u>)	Borehole dia(s): <u>4 1/4"</u>
Drig Method/Rig Type: <u>Air Hammer Casing</u>		
Logged by: <u>GREENWALD</u>	E-Log (Y/N): <u>(N)</u>	From <u> </u> to <u> </u> Protection Level: <u>D (MODIFIED)</u>

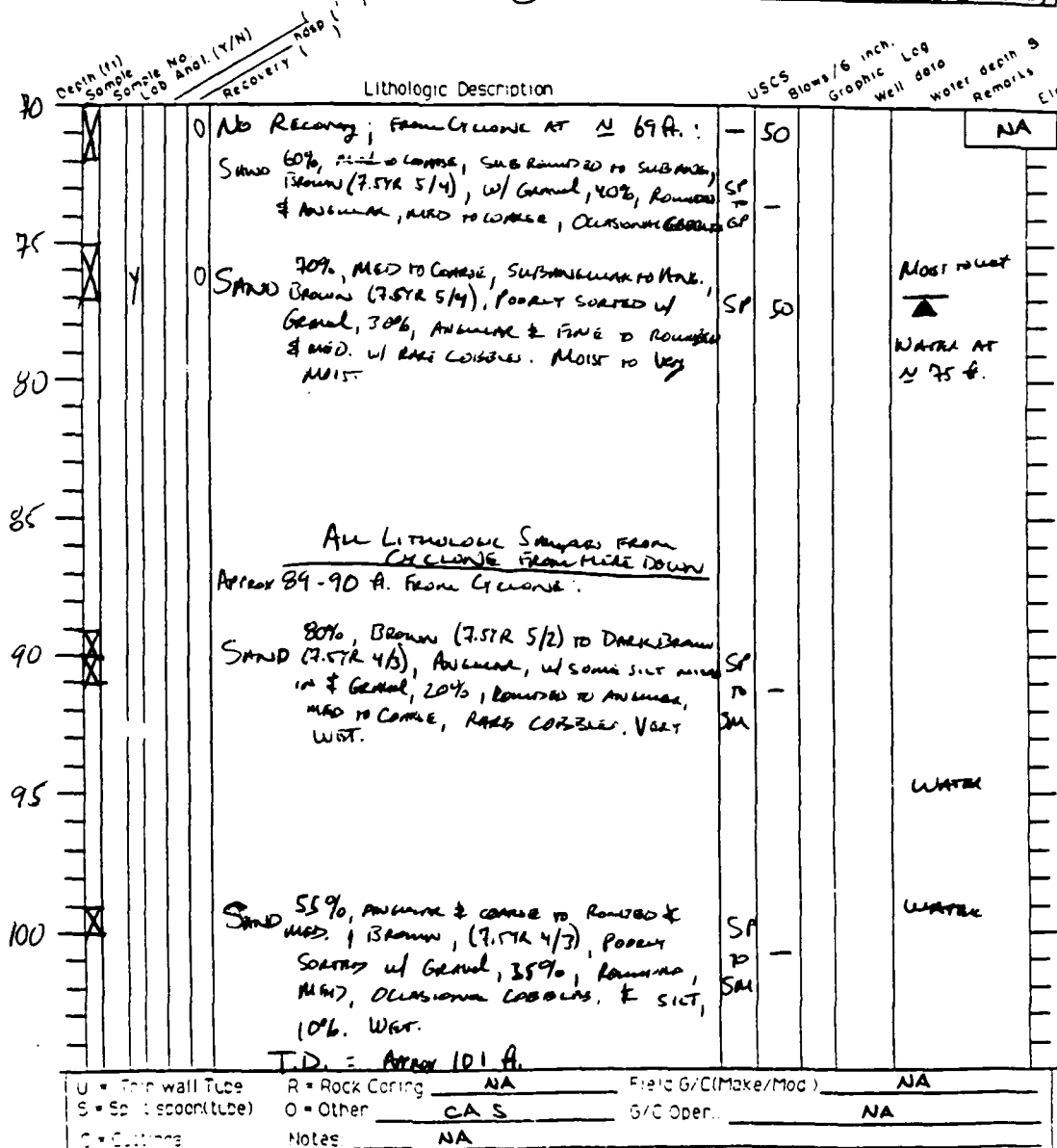


FIGURE 5-3a

REV DATE MAY 990

BORING LOG	BORING/ WELL NO	SBL-02		Page	1	of	2
Installation	Sky Harbor	Coordinates:	Site 1				
Project No	40921-53	Client/Project	HAZWRAP / Sky Harbor ANG				
HAZWRAP Contractor	IT Corporation	Drill Contractor	LAKE ENVIRONMENTAL	Driller	DEERY LOODRA		
Drill Started	2/4/01 1100 C.M.	Drill Ended	2/5/01 1300 P.M.	Borehole dia(s)	9 3/4"		
Drill Method/Rig Type	AIR Hammer CASING						
Logged by	GMD/NER	E-Log	(N)	From	to		Protection Level
				D (MODIFIED)			

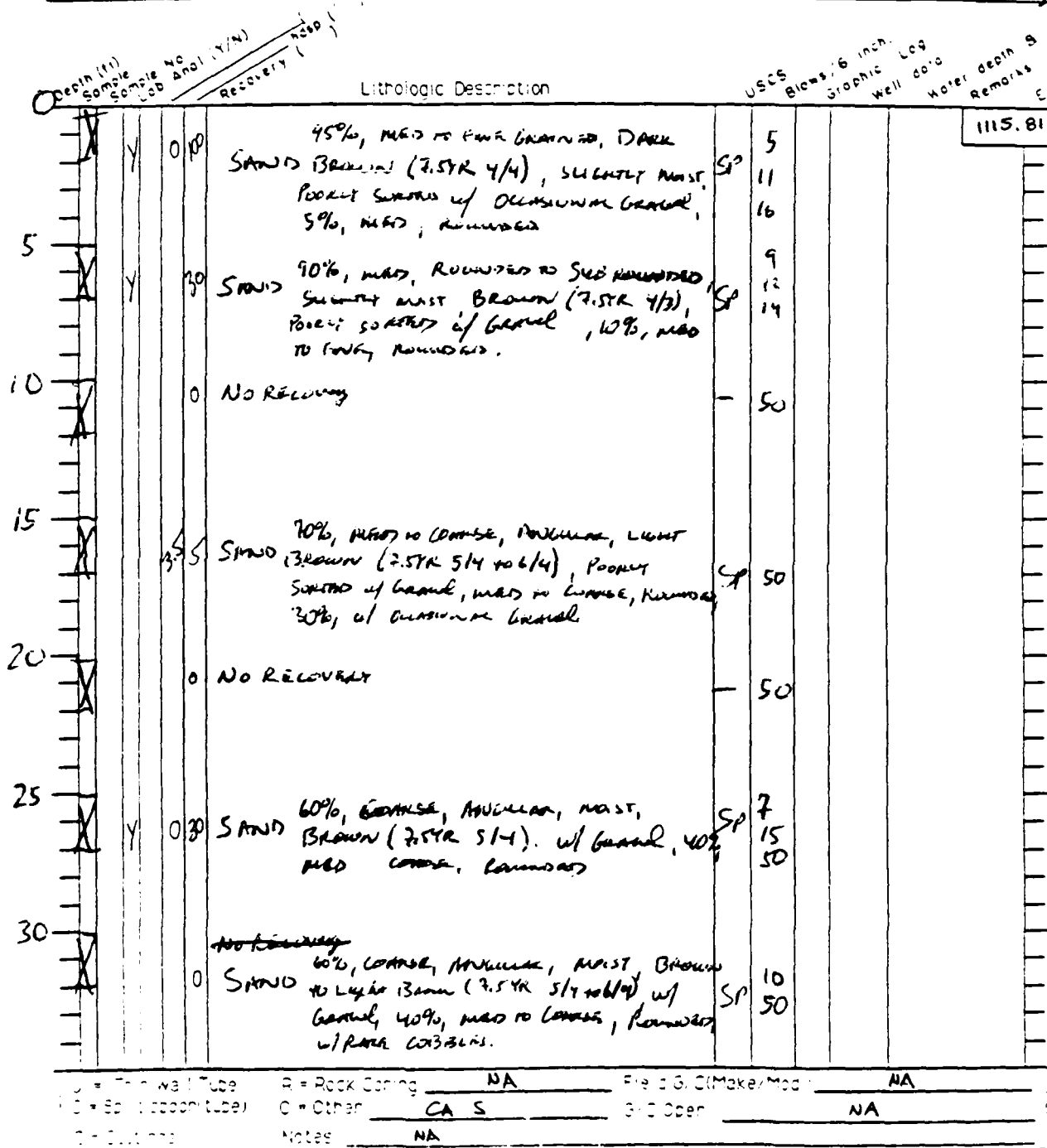


FIGURE 5-3a

REV DATE MAY 1997

BORING LOG	BORING WELL NO	SB1-02		Page	2 of 2
Installation	Sky Harbor	Coordinates:	Site 1		
Project No	405221-01	Client/Project	HAZLOREN / Sky Harbor Air		
HAZWPAP Contractor	IT Corporation	Drill Contractor	James Environmental	Driller	Dennis Lopez
Drill Started	2/4/91 10:00 A.M.	Drill Ended	2/5/91 12:00 P.M.	Borehole dia (in)	9 3/4"
Drill Method/Rig Type	AIR Hammer Casing				
Logged by	GARDINER	Entered by	RAJ	From	to
				Protection Level	D (Medium)

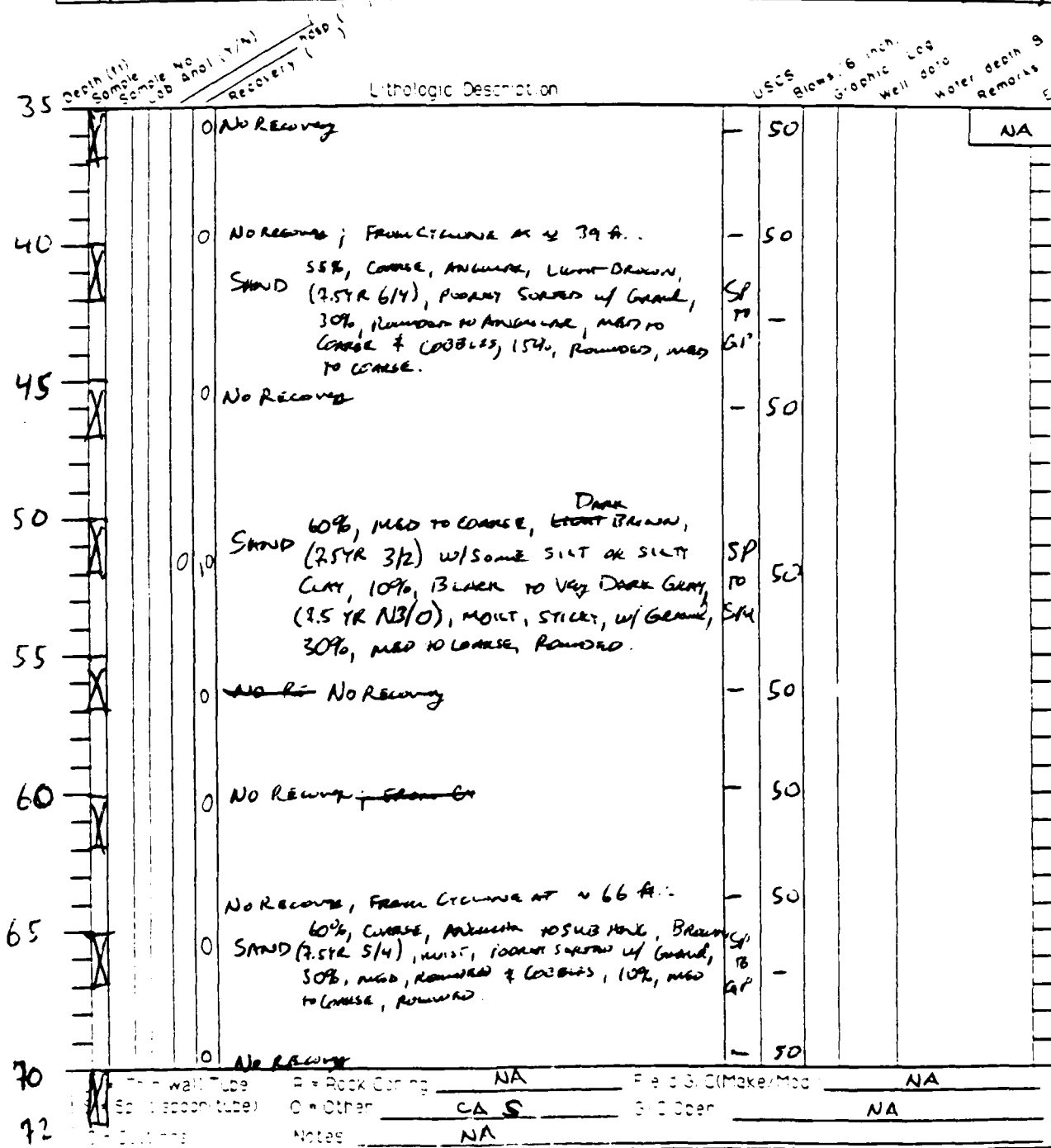


FIGURE 5-3a

REV DATE MAY 990

BORING LOG	BORING WELL NO	501-03	Page	1	of	2	
Installation	Sky Harbor	Coordinates:	Site	1			
Project No	40134.000	Client/Project	HAZWRAP / SKY HARBOR AREA				
HAZWRAP Contractor	IT Corporation	Drill Contractor	LYNNE ENVIRONMENTAL	Driller	Dwaine Pappas		
Drill Started	1/21/91	(1800 E.M.)	Drill Ended	1/22/91	(0930 E.M.)	Borehole dia(s)	9 3/4"
Drill Method/Rig Type:	AIR Hammer Casing (Permeation)						
Logged by	GATLIS	E-Log	(N)	From	to	Protection Level	D (medium)

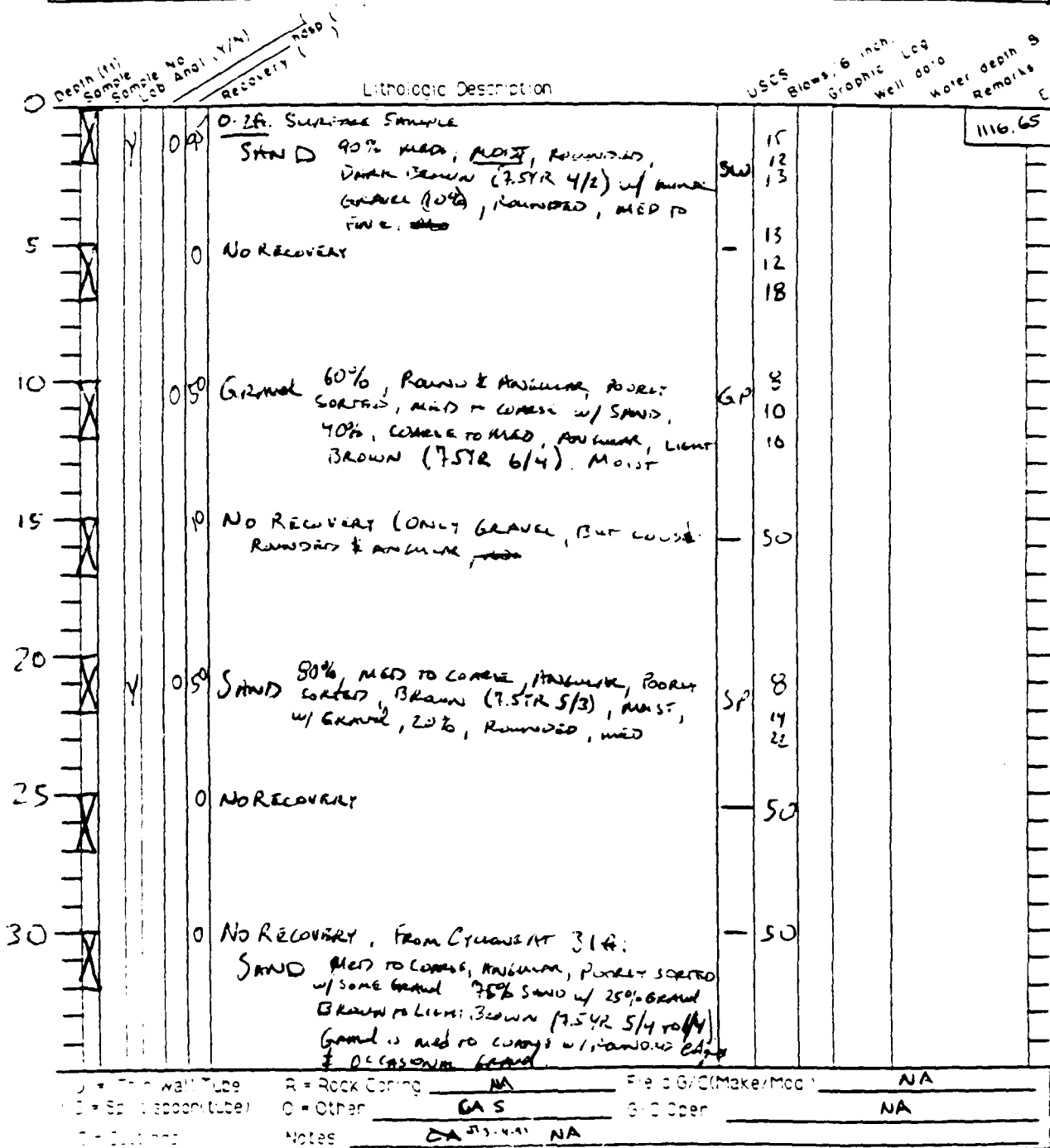


FIGURE S-3a

REV DATE MAY 99C

BORING LOG	BORING/WELL NO	531-03	Page	2	of	2
Installation	Sky Harbor	Coordinates:	Site	1		
Project No	457216-1	Client/Project	HAWRAP/Sky Harbor ANG			
HAWRAP Contractor	ITC Corporation	Drill Contractor	Long Environmental	Driller	Dwight Peterson	
Drill Started	1/21/91	(13 00 p.m.)	Drill Ended	1/22/91	(9 30 A.M.)	Borehole dia(s)
Drill Method/Rig Type: Air Hammer Casing (1 recovery)						9 1/4"
Logged by	GARDNER	Entered	(N)	From	to	Protection Level
						D (MODIFIED)

Depth (ft)	Sample No	Sample Lab	Anal (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well 6010	Water depth	Remarks
35	X			0	SAND 80%, coarse, angular, light brown (7.5YR 6/4), moderately sorted (but w/ gravel, 80%, angular & round, med. moist.	SW	16				NA
40	X			0	No Recovery		50				
45	X			0	No Recovery. From Casing at 45 ft.		50				
50	X			0	Gravel 75%, rounded to angular, med to coarse w/ some large cobbles, w/ sand, 25%, rounded to angular, med to coarse, light brown (7.5YR 6/4).	GP					
55	X			0	From Casing: Gravel 60%, rounded to angular, coarse w/ some some fragments & occasional large gravel, w/ sand, 40%, angular, med to coarse, lt. brown (7.5YR 6/4). Moist.	GP	50				
60	X			0	SAND SILTY TO CLAYEY, 90%, dark brown, poorly sorted (7.5YR 3/2), moist, w/ gravel, 10%, rounded, fine to med.	SM SC	21 25 27				
65	X			0	No Recovery		50				
70	X			0	No Recovery. From Casing at 64 ft.		50				
72	X			0	SAND 50%, med to coarse, angular, brown (7.5YR 5/4) w/ gravel, 50%, med to coarse, rounded to angular & occasional cobbles.	SP SP					
75	X			0	No Recovery. From Casing at 69-70 ft.		50				
78	X			0	SAND 70%, med to coarse, angular w/ some fine, brown (7.5YR 5/4) w/ gravel, 30%, med to coarse, rounded to angular & occasional cobbles.	SP					
80	X			0	Thin wall tube	NA					NA
82	X			0	Sp. 1 second tube	NA					NA
84	X			0	Notes	NA					

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO	S31-04 (MODIFIED)		Page	1 of 2
Installation	Sky Harbor	Coordinates:	Site 1		
Project No	40721.02	Client/Project	HAZWAP / Sky Harbor ANA		
HAZWAP Contractor	IT CORPORATION	Drill Contractor	LARSEN ENVIRONMENTAL	Driller	DANIEL PETERSON
Drill Started	1/21/91 0830 ± m	Drill Ended	1/21/91 1200 ± m	Borehole dia(s)	9 3/4"
Drill Method/Rig Type	AIR HAMMER CASING (PRECISION)				
Logged by	GARDNER	E-Log	Y (P)	From	to
				Protection Level	D (MODIFIED)

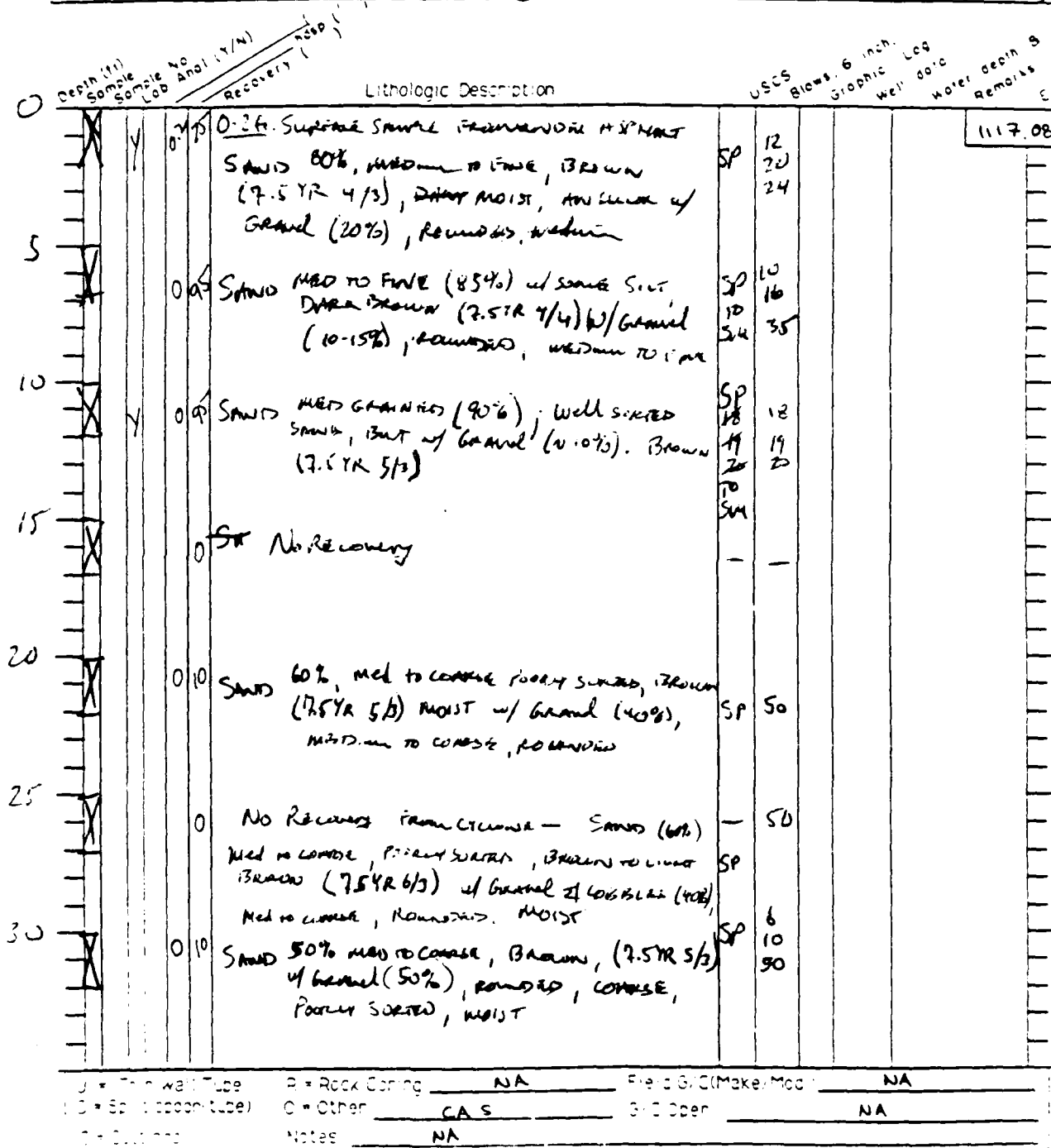


FIGURE 5-3a

REV DATE MAY 990

BORING LOG	BORING/WELL NO	SB1-04 (Modified)		Page 2 of 2
Installation	Sky Harbor	Coordinates:	Site	
Project No.	409221-02-04	Client/Project	HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor	IT Corporation	Drill Contractor	Lance Engineering	Driller
Drill Started	1/21/91 10:30 A.M.	Drill Ended	1/21/91 12:00 P.M.	Borehole dia(s)
Drill Method/Rig Type: Air Hammer Casing (Percussion)				
Logged by	GARDINER	E-Log	(N) From	to
				Protection Level

Depth (ft)	Sample No	Sample No	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well depth	Water depth	Remarks
35				No Recovery		50				NA
40				Little Recovery (5%) Gravel, med to coarse, 100%. Roundish moist.		50				
45				From CYCLONE AT 42 ft: SAND (50%), med to coarse, LIGHT BROWN (7.5YR 6/4), angular w/ gravel, 100% sorted, 50%, angular & rounded.		50				
45-47 ft				No Recovery		50				
50				No Recovery		50				
55				SAND 80%, med to coarse, DARK BROWN (7.5YR 3/3), MOIST w/ Gravel (20%), ROUNDED MED TO FINE, SAND SILT IN SAND NEAR TOP	SP	13 23 21				WET CUTTING AT 55 ft
60				No RECOVERY: CYCLONE HAS MOIST SAND MAY BE IN WATER		50				
65				No Recovery		50				
70				No Recovery. From CYCLONE: SAND & SILT SAND w/ some gravel. 75% sand & 25% gravel. med to coarse, BROWN (7.5YR 3/3). Gravel is med to coarse, ROUNDED & ANGULAR. MOIST TO WET.	SP	50				NONE WATER WET CUTTING

Test well Tube	R = Rock Coring	NA	Field S (Maker/Mod)	NA
Sp. (depth) (ft)	O = Other	CA S	S. C. Oper	NA
Notes	NA			

FIGURE S-3a

REV DATE MAY 1990

BORING LOG	BORING WELL NO	S01-05		Page	1	of	2
Installation	Sky Harbor	Coordinates:	Site 1				
Project No.	407321-02-06	Client/Project:	HAZWRAP / SKY HARBOR ANV				
HAZWRAP Contractor	IT Corporation	Drill Contractor	LATHE ENGINEERING	Driller	ART RODRIGUEZ		
Drill Started	11/8/91	(10.20 E m)	Drill Ended	11/8/91	(16.35 E m)	Borehole dia(s)	9 3/4"
Drill Method/Rig Type:	AIR PERCUSSION HAMMER						
Logged by	GARDNER	E-Log	(N)	From	to	Protection Level	D (MODIFIED)

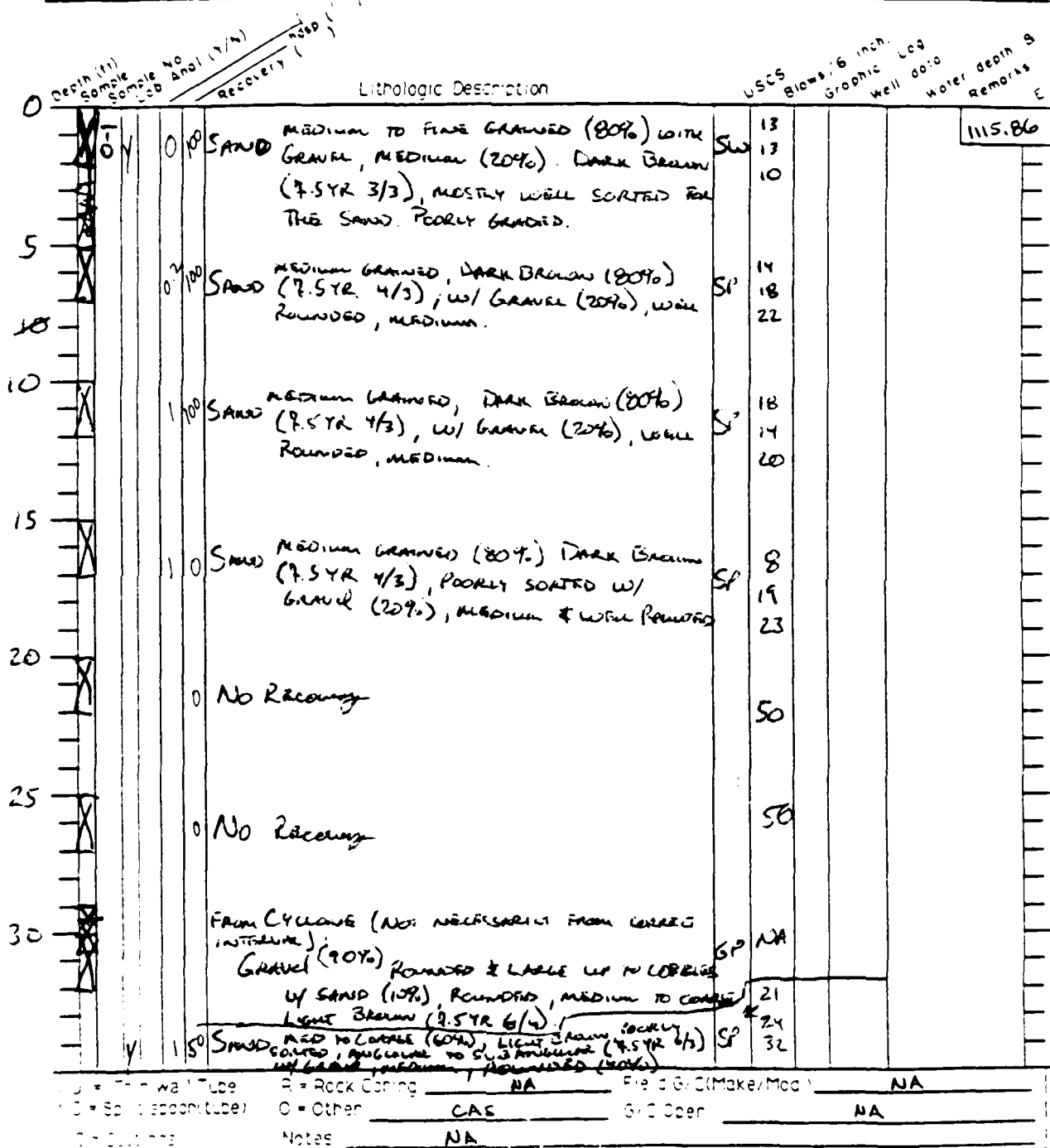
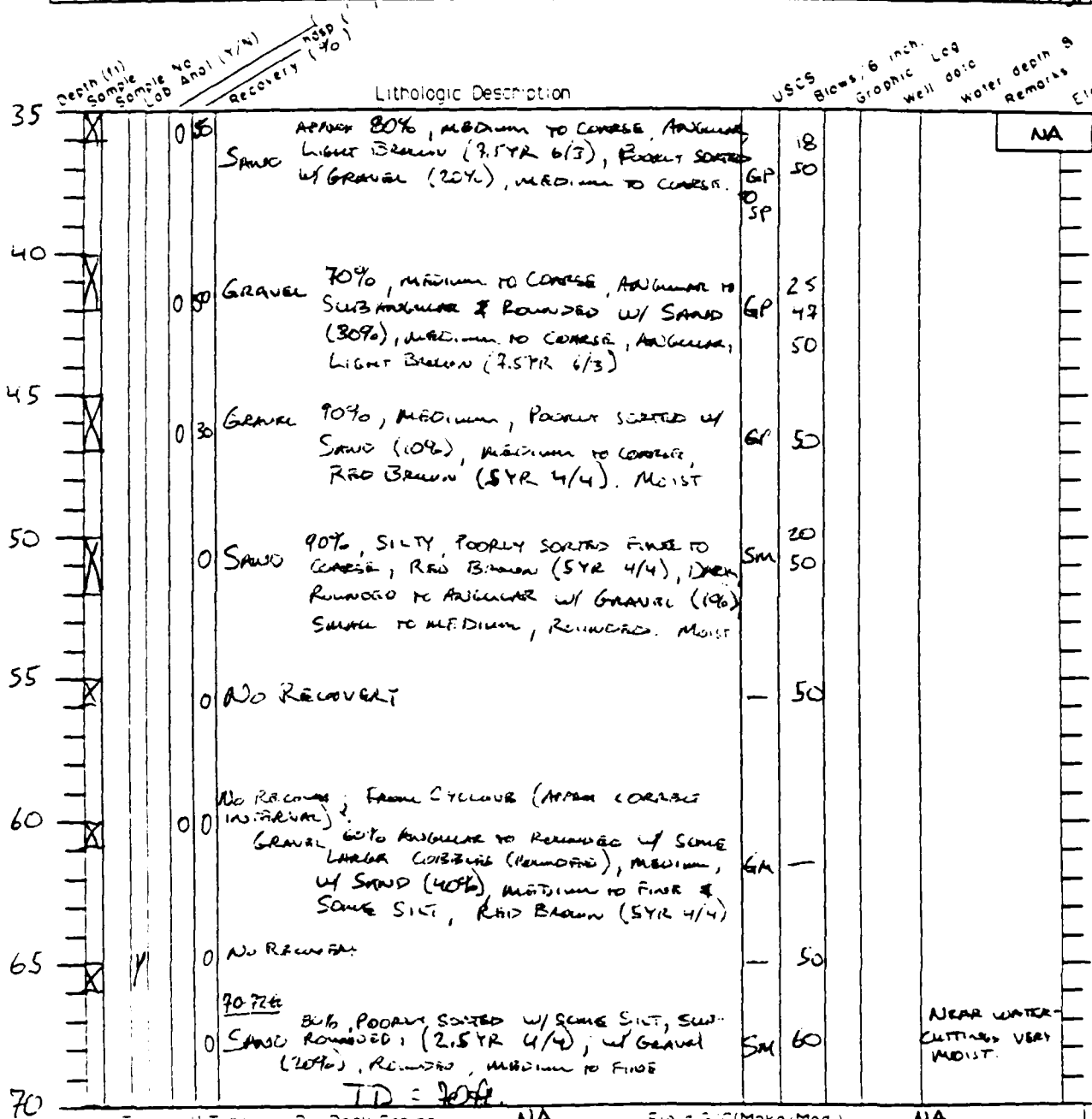


FIGURE 5-3a

REV DATE MAY 990

BORING LOG	BORING/WELL NO	SB1-05		Page	2	of	2
Installation	Sky Harbor	Coordinates:	Site		1		
Project No	401321.07.01	Client/Project	HAZWAN / SMT MARZEN ANIG				
HAZWPAD Contractor	IT Corporation	Drill Contractor	LAWSON ENVIRONMENTAL		Driller	ART RODRIGUEZ	
Drill Started	11/18/91	(10:20 A.M.)	Drill Ended	11/18/91	(4:25 A.M.)	Borehole dia(s)	9 3/4"
Drill Method/Rig Type	AIR PERCUSSION HAMMER						
Logged by	GARDNER	E-Log	Y	From	to	Protection Level	D (MODIFIED)



1 = Thin wall Tube	R = Rock Coring	NA	Field G/C (Maker/Mod)	NA
2 = Split spoon (tube)	O = Other	CA S	G/C Open	NA
3 = Cuttings	Notes	NA		

FIGURE 5-3a

REV. DATE MAY 990

BORING LOG	BORING WELL NO	MLWZ-07		Page	1	of	3
Installation	Sky Harbor	Coordinates:	Site		2		
Project No.	4092260206	Client/Project	HAZWRAP / Sky Harbor ANJG				
HAZWRAP Contractor	ITC Corporation	Drill Contractor	LAWSON Environmental		Driller	DANIEL LORRAN	
Drill Started	2/6/91	Drill Ended	2/6/91	16 20 ft	Borehole dia(s)	9 3/4"	
Drill Method/Rig Type	Air Hammer Casing						
Logged by	GARDINER	E-Log	(N)	From	to		Protection Level: D (and F)

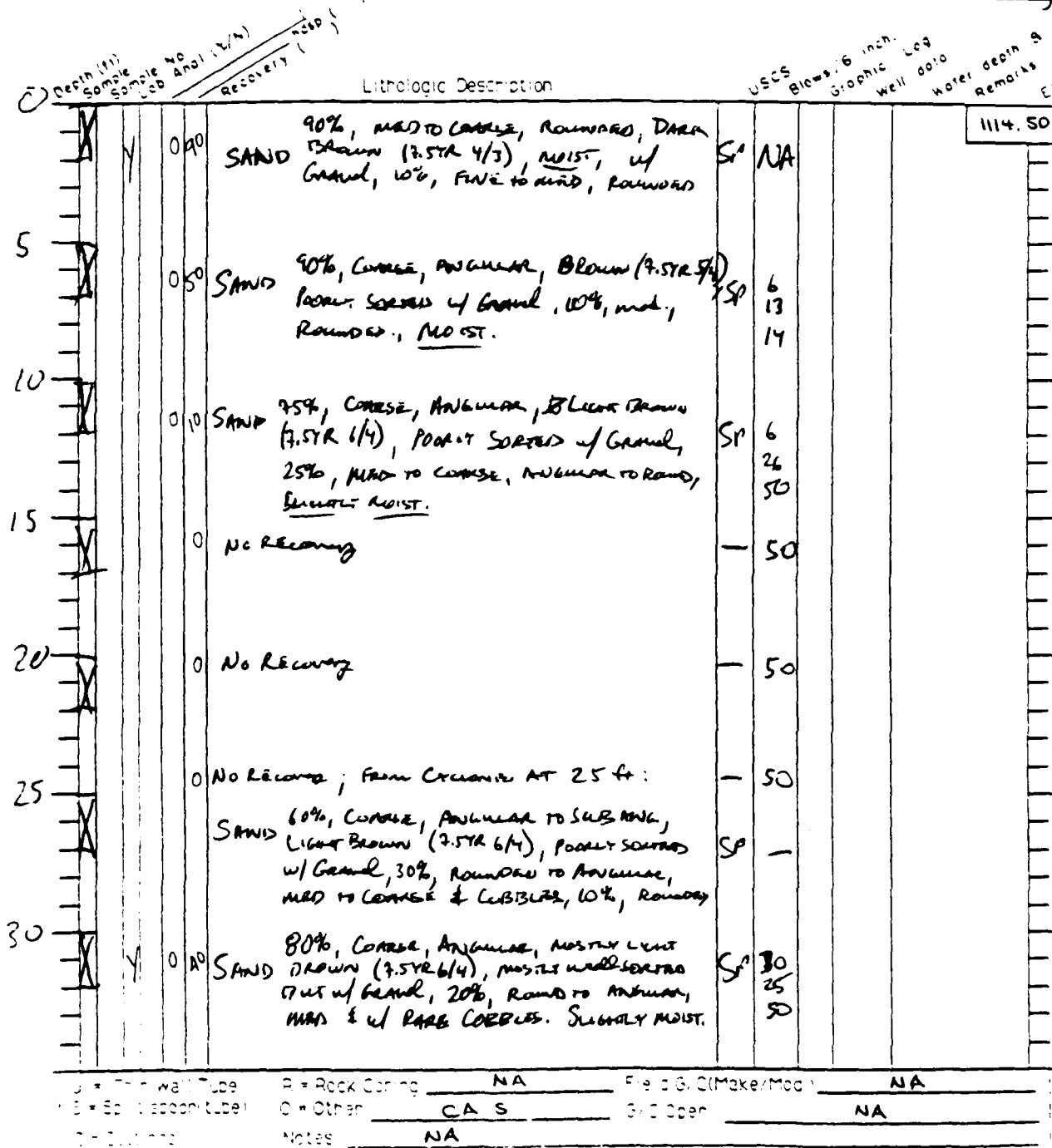


FIGURE 5-3a

REV DATE MAR 1990

BORING LOG	BORING WELL NO	MW2-02	Page	2	of	3	
Installation	Sky Harbor	Coordinates:	Site	2			
Project No	40421-83	Client/Project	HAZWRAP / Sky Harbor ANJ				
HAZWRAP Contractor	ITC Corporation	Drill Contractor	LARSEN Environmental	Driller	Darryl Loefer		
Drill Started	2/6/91	(10:55 A.M.)	Drill Ended	2/6/91	(5:20 P.M.)	Borehole dia(s)	9 3/4"
Drill Method/Rig Type	Air Hammer Casing						
Logged by	GARDNER	E-Log	(N)	From		to	
						Protection Level	D (Modified)

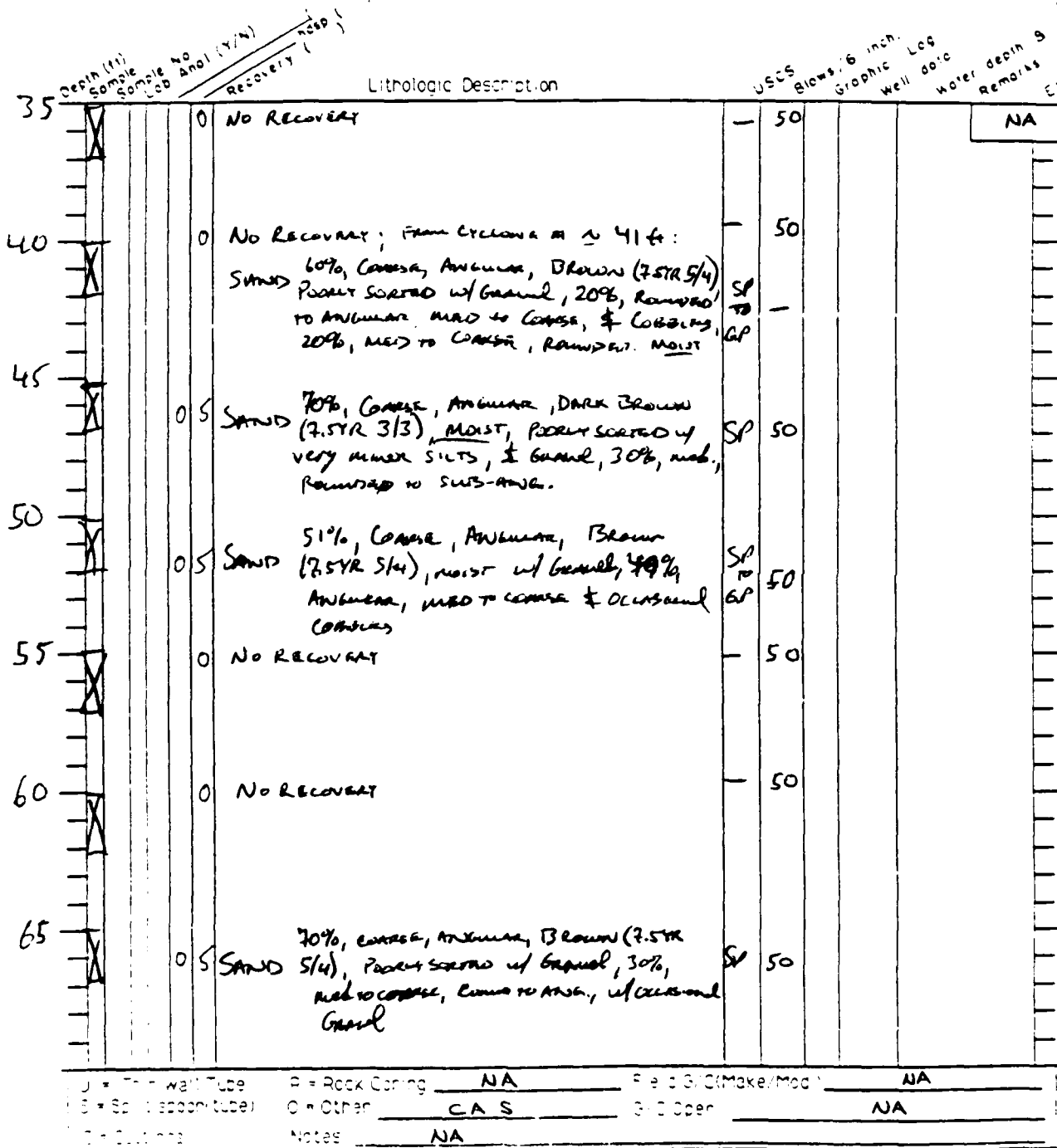


FIGURE 5-3a

REV DATE MAY 1991

BORING LOG	BORING WELL NO	MW2-OL	Page	3	of	3
Installation	Sky Harbor	Coordinates:	Site	2		
Project No.	40921.02	Client/Project	HAZWRAP/SKY HARBOR ANV			
HAZWRAP Contractor	IT Corporation	Drill Contractor	Lewis Engineering	Driller	Darryl Locke	
Drill Started	2/6/91	Drill Ended	2/6/91	16:20	PM	Borehole dia
Drill Method/Rig Type	Air Hammer Casing					9 3/4"
Logged by	GARDNER	E-Log	(N)	From		to
						Protection Level
						D (modified)

Depth (ft)	Sample No	Sample Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
70				90% Coarse, Angular, Brown SAND (7.5R 5/4), more well sorted but w/ gravel, 10%, rounded, med to fine, very moist.	SW TO SP	17 TO 30				NA
75				From Casing from hole to T.D.						
80				75% Coarse, Angular Brown to Dark Brown (7.5R 4/4), poorly sorted w/ gravel, 20%, med to coarse, rounded to angular, & cobbles, 5%, rounded, med to coarse	SP	-				Very moist clumps.
85										
90				65% Coarse, Angular to sub ang, Dark Brown (7.5R 4/4), poorly sorted w/ gravel, 35%, med to coarse, med to sub rounded & occasional very coarse cobbles (RND)	SP TO GP	-				
95										Free water at 99.5 ft.
100				Sand/Water/Gravel & coarse rounded, Free water, Brown (7.5R 5/4). Rounded to angular med to coarse gravel & cobbles.						
				T.D. = 101 ft.						

J = Thin wall Tube

R = Rock Core

NA

File # G/C (Make/Mod)

NA

S = Sp. (spoon/tube)

O = Other

CA S

G/C Oper.

NA

Q = Casing

Notes

NA

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: SB2-01	Page 1 of 2
Installation Sky Harbor	Coordinates:	Site 2
Project No. 409721.02-06	Client/Project: HAZWRAP / Sky Harbor Air	
HAZWAP Contractor IT Corporation	Drig Contractor LARSEN Environmental	Driller Dean Lopez
Drig Started 1/21/91 (0805 A.M.)	Drig Ended 1/29/91 9:40 A.M.	Borehole dia(s) 9 3/4"
Drig Method/Rig Type: Air Hammer Casings		
Loaded by: GARDNER	E-Log (Y/N) From to	Protection Level D (MODIFIED)

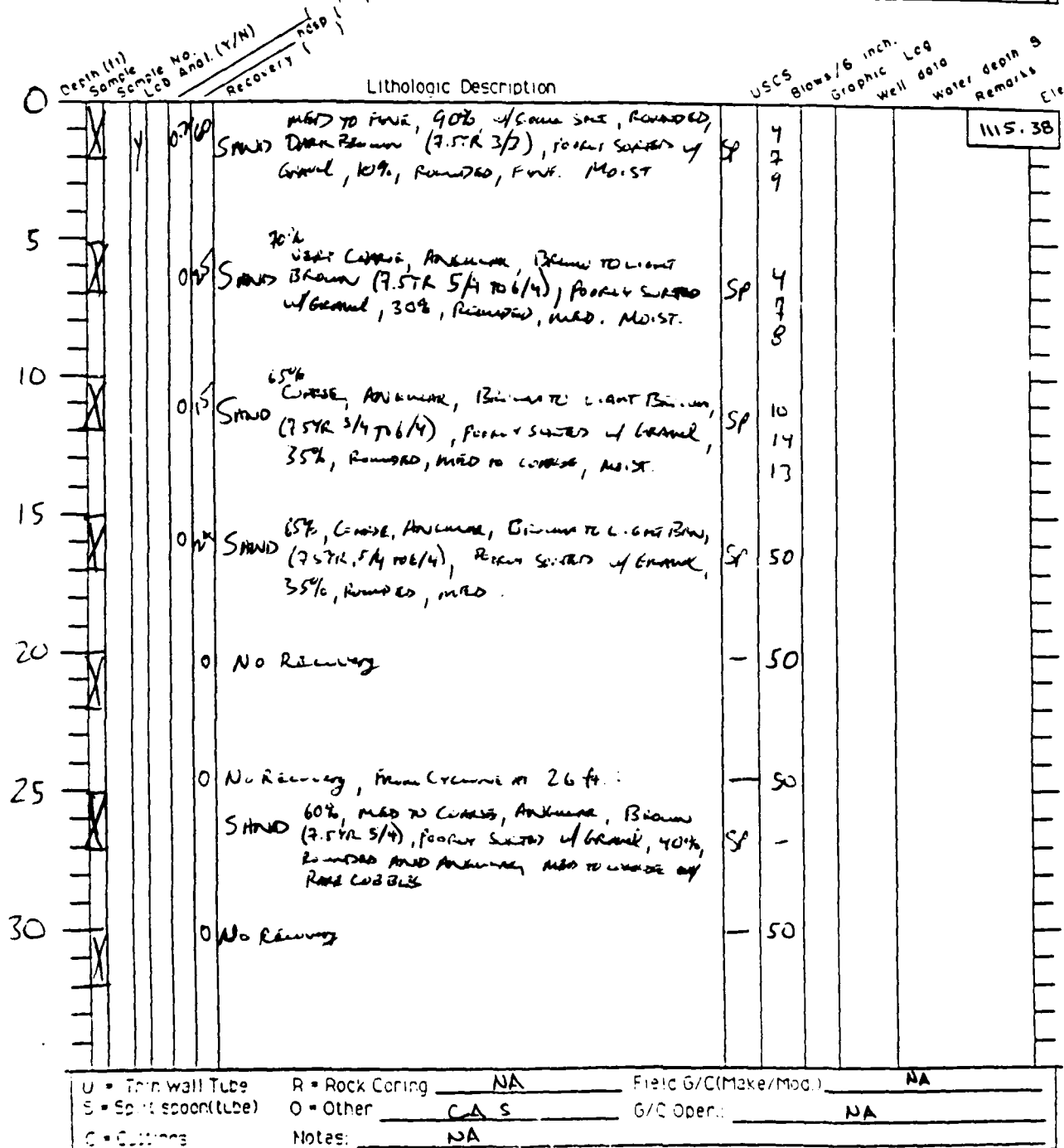


FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO.: 502-01	Page 2 of 2
Installation: Sky Harbor	Coordinates:	Site: 2
Project No. 407221.02.00	Client/Project: HAZWOP / Sky Harbor AMU	
H42WAP Contractor: IT Corporation	Drill Contractor: LAMAR ENVIRONMENTAL	Driller: Denny Looze
Drill Started: 1/24/91 (12:05 A.M.)	Drill Ended: 1/24/91 (11:40 A.M.)	Borehole dia(s): 93A"
Drill Method/Rig Type: Air Hammer Casing		
Logged by: GARDNER	E-Log (Y/N): (Y) From _____ to _____	Protection Level: D (Modified)

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well depth	Water depth	Remarks	Elev.
35				0 No Recovery; Fracture zone at N 36 ft: SAND 30% coarse, angular, light brown (7.5YR 6M), poorly sorted w/ gravel, 30% rounded to medium, med to fine, moist.	SP	50					NA
40				0 No Recovery		50					
45				0 No Recovery; Fracture zone at N 46 ft: 60% angular, med, light brown SAND (7.5YR 6/4), poorly sorted w/ gravel, 35% rounded to sub angular, med to coarse, rare cobbles.	SP	50					
50				0 SAND 95% coarse, angular, light brown (7.5YR 5/4), mostly well sorted but w/ 1-5% gravel, med, rounded, moist	SW to SP	50					
55				0 SAND 55% coarse, angular to sub ang, brown (7.5YR 5/4), poorly sorted w/ gravel, 45% rounded to sub rounded, med. moist	SP	50					
60				0 SAND 50% coarse, angular, brown (7.5YR 5/4), poorly sorted w/ gravel, 50% rounded to sub angular, med. moist. Very poor Recovery.	SP to SP	50					
65				0 No Recovery		50					
70				0 No Recovery; Fracture zone at N 70 ft: 50% angular to sub ang, med to coarse, brown (7.5YR 5/4), poorly sorted w/ gravel, 50% rounded to sub angular, med to coarse w/ occasional cobbles.	SP	50				Very moist, N 70 ft water	
72				0 Thin wall Tube	NA						
				0 Rock Coring	NA						
				0 Other	CAS						
				0 Casing	NA						
				Notes:	NA						

T.D. = N 70 ft.

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. <u>SR2-02 (02)</u>	Page <u>1</u> of <u>2</u>
Installation <u>Sky Harbor</u>	Coordinates:	Site <u>Site 2</u>
Project No. <u>40921.02.2</u>	Client/Project <u>HAZWRAP / Sky Harbor ANJ</u>	
HAZWRAP Contractor <u>IT Corporation</u>	Drig Contractor <u>LYAN Environmental</u>	Driller <u>Dennis Johnson</u>
Drig Started <u>1/22/91</u>	<u>41.00</u> m	Drig Ended <u>1/22/91</u> <u>49.30</u> m
Drig Method/Rig Type: <u>Air Percussion Hammer Coring</u>		Borehole dia(s) <u>7 3/4"</u>
Logged by <u>Cassian</u>	E-Log <u>Y</u>	From <u> </u> to <u> </u>
		Protection Level <u>D (Modified)</u>

Depth (ft)	Sample No	Sample Lab Anal (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows 6 inch	Graphic Log	Well logs	Water depth	Remarks
0				SAND SILTY, FINE TO MEDIUM GRAINED, DARK BROWN, (2.5YR 4/2) MOIST.	SM	9 4 5				1115.59
5				SAND SILTY, FINE TO MEDIUM, DARK BROWN (2.5YR 4/2), MOIST	SM	6 7 10				
10				SAND SLIGHTLY SILTY, FINE TO MEDIUM, BROWN (7.5YR 5/4), SLIGHTLY MOIST w/ MINOR SILT.	SM	8 10 16				
15				0 NO RECOVERY		50				
20				0 NO RECOVERY		50				
25				FROM CYCLONE AT 26 ft. SAND 60%, med to coarse, angular, light brown (7.5YR 6/4) w/ gravel, 40%, med to coarse of some cobble, rounded. Dry	SP	50				
30				0 NO RECOVERY FROM CYCLONE AT 29 ft. SAND 75%, med to coarse, angular, light brown (7.5YR 6/4) w/ gravel, 25%, coarse, rounded & angular, occasional cobbles	SP	50				

U = Thin wall Tube	R = Rock Coring	NA	Field G/C (Make/Model)	NA
S = Sp. (spoon/tube)	O = Other	CA S	G/C Oper	NA
C = Cuts	Notes	NA		

FIGURE 5-3a

BORING LOG		BORING/WEEL NO. 502-02		REV DATE MAY 1990	
Installation Sky Harbor		Coordinates:		Page 2 of 2	
Project No. 40321-02-01		Client/Project: HAWAIIAN / SKY HARBOR / 10%		Site 2	
HAZWRAP Contractor IT Corporation		Drill Contractor LANE Environmental		Driller Daniel Brown	
Drill Started 1/22/91 (11:00 A.M.)		Drill Ended 1/22/91 (1:30 P.M.)		Borehole dia(s) 9 7/8"	
Drill Method/Rig Type: Air Percussion Hammer Cable					
Logged by Gardner		E-Log: (N)		From _____ to _____	
Protection Level D (Medium)					

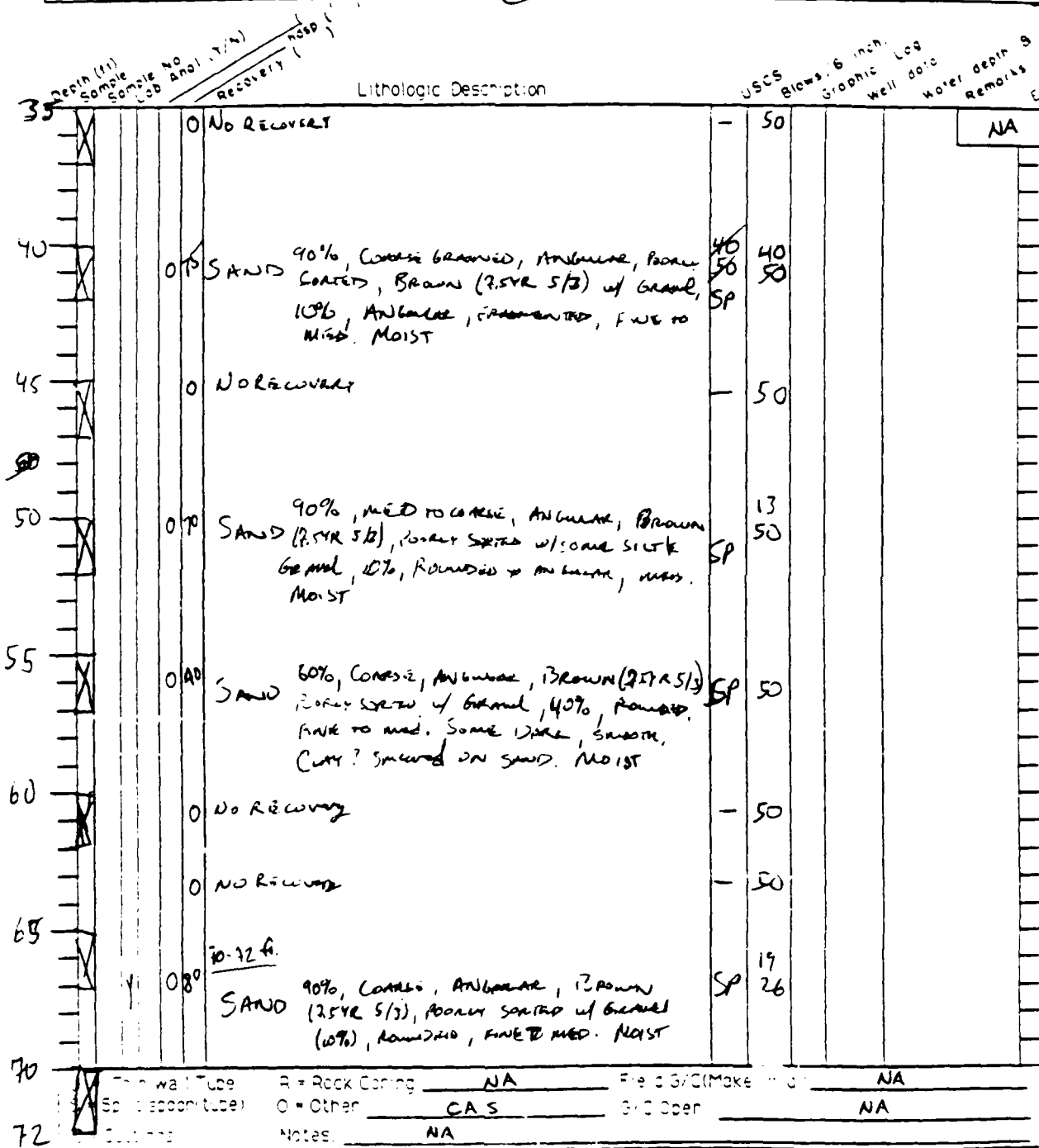


FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING WELL NO	382-04	Page	1	of	2
Installation	Sky Harbor	Coordinates:	Site	2		
Project No	404221-06	Client/Project	HAWAIIAN / Sky Harbor Airfield			
HAWAIIAN Contractor	IT Corporation	Drill Contractor	LAYNE ENGINEERING	Driller	Dwight Peterson	
Drill Started	1/22/91	(15.05 F.M.)	Drill Ended	1/22/91	(10.30 A.M.)	Drill Hole dia (s)
Drill Method/Rig Type:			AIR Percussion Hammer Casing			
Logged by	GARDNER	E-Log	(N)	From	to	Protection Level: D (Medium)

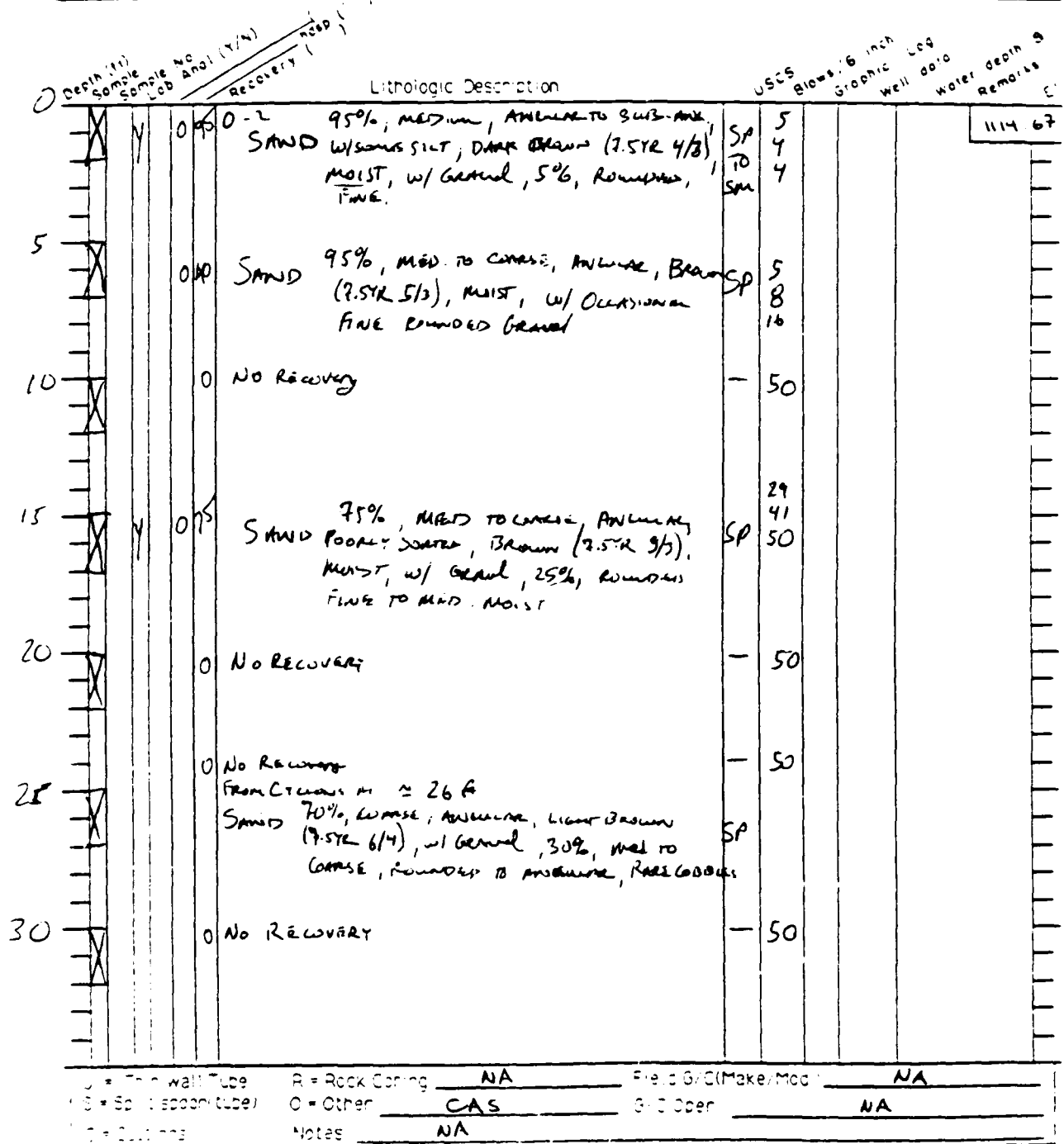


FIGURE 5-3a

BORING LOG	BORING WELL NO	REV DATE MAY 990
Site: Sky Harbor	S32-04	Page 2 of 2
Project No: 409711-06	Client/Project: HAZWRAP / Sky Harbor ANG	Site: 2
HAZWRAP Contractor: IT (unintelligible)	Drill Contractor: LARRY'S ENVIRONMENTAL	Driller: DANIEL PEREZ
Drill Bit: 1/22/11	Drill Ended: 1/22/11	Borehole dia: 9 3/4"
Drill Method/Rig Type: Air Percussion Hammer Casing		
Logged by: GARDINER	E-Log: (N)	From: _____ to: _____
		Protection Level: D (unintelligible)

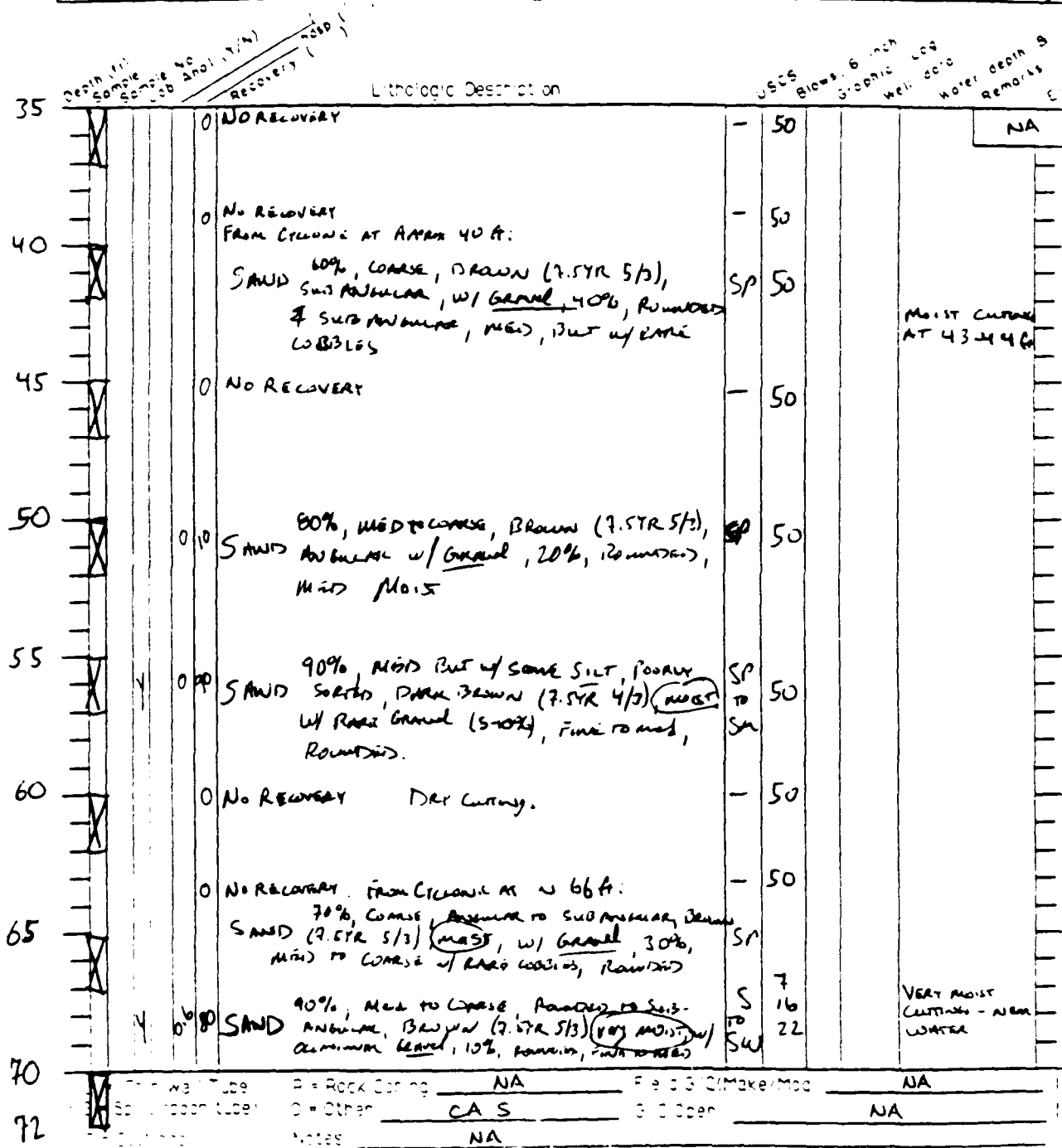
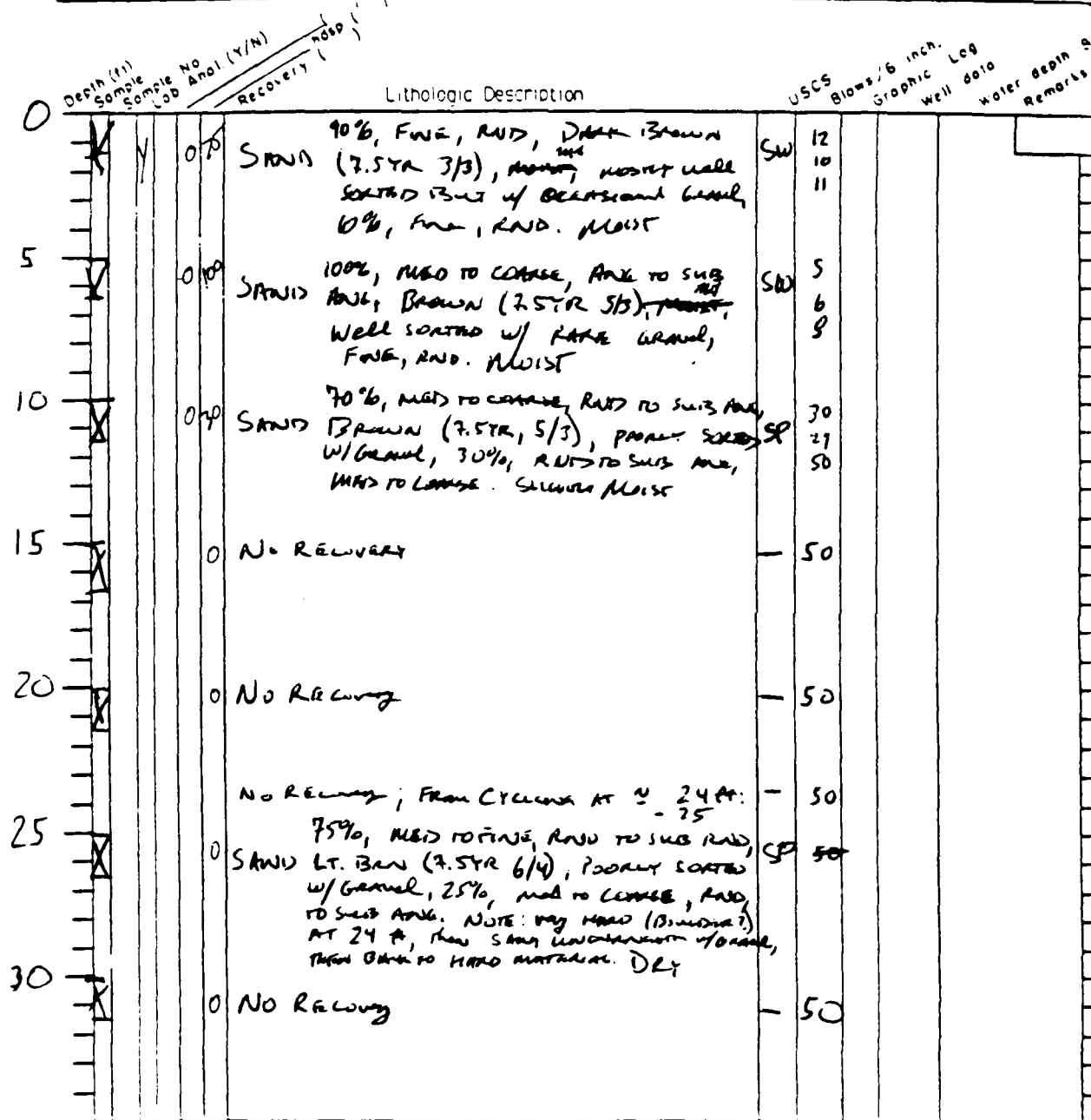


FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO	MW3-01	Page	1 of 2
Installation	Sky Harbor	Coordinates:	Site	3
Project No.	401331-06	Client/Project	HAZWRAP / Sky Harbor ANV	
HAZWRAP Contractor	IT Corporation	Drill Contractor	LAYNE Environmental	Driller
Drill Started	3/12/91 (6 30 A.M.)	Drill Ended	3/22/91 (3 30 P.M.)	Borehole dia(s)
Drill Method/Rig Type	DUAL TUBE PERCUSSION			
Logged by	GARDNER	E-Log	Y / N	From _____ to _____
		Protection Level	D (MODIFIED)	



U = Thin wall Tube

R = Rock Coring

Field G/C (Make/Mod.)

S = Soil Spoon Tube

O = Other

G/C Oper

C = Cuts

Notes

FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO	MWJ-01		Page	2	of	3
Installation	Sky Harbor	Coordinates:	Site: 3				
Project No.	40741-06	Client/Project	HAZWRAP / Sky Harbor ANG				
HAZWRAP Contractor	IT Corporation	Drill Contractor	LAYNE ENGINEERING	Driller	DUNCAN PERMAN		
Drill Started	3/22/91 @ 30.0 m	Drill Ended	3/22/91 @ 30.2 m	Borehole dia(s)	10 3/4"		
Drill Method/Rig Type	DUAL TUBE PERCUSSION						
Logged by	GARDNER	E-Log	Y / (N)	From	to		Protection Level D (modified)

Depth (ft)	Sample No	Sample Lab	Anal (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	005				80% med to coarse, med to sub ang SAND BROWN (7.5YR 5/3 to 4/3), poorly sorted w/ minor silt & gravel, 20% med to fine, med. Very moist.	SP	50				
40	010				90% med to coarse, med, BROWN (7.5YR 4/3), poorly sorted w/ silt, 10% fine, BROWN, & gravel, 20% med to coarse, med to sub ang. Very moist.	SP	50				
45	015				55% med to coarse, med, BROWN (7.5YR 4/3), poorly sorted w/ gravel, 45% med to coarse, med to sub ang. MOIST. NOT enough sample to analyze.	SP TO GP	50				
50	020				75% med to coarse, med to sub ang SAND BROWN (7.5YR 4/3), poorly sorted w/ silt, 30% fine, BROWN, & gravel, 20% med to coarse, med to sub ang. MOIST.	SP	50				
55	025				80% med to coarse, med, BROWN (7.5YR 4/3), poorly sorted w/ gravel, 20% med to coarse, med to sub ang. MOIST	SP	36 50				
60	030				40% med to coarse, med, BROWN (7.5YR 4/3), poorly well sorted w/ occasional gravel, 10% fine, med, & some silt. MOIST	SW TO SP	32 50				
65	0				No Recovery	-	50				

U = Thin wall Tube
S = Spoon (tube)
C = Cylinders

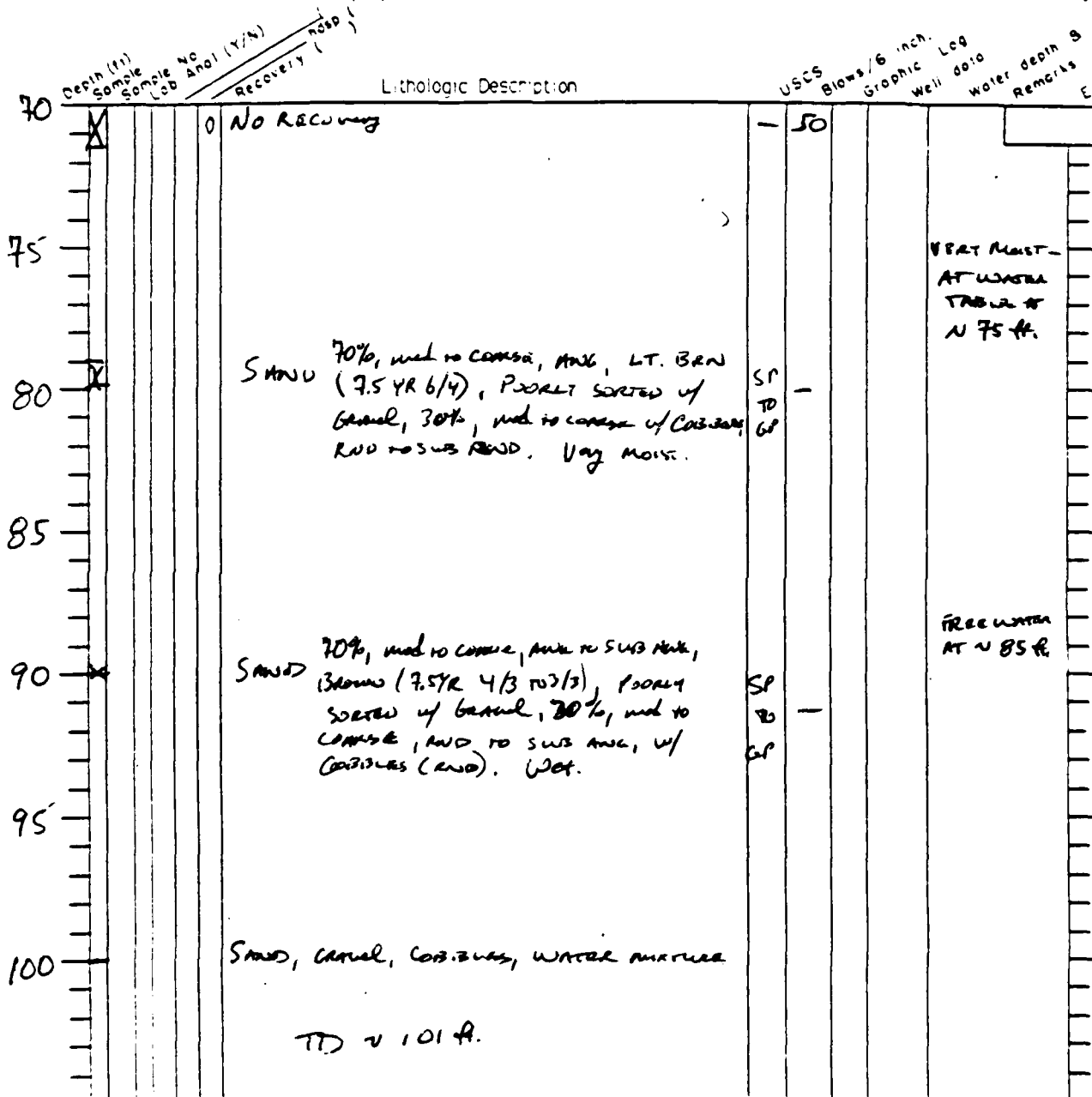
R = Rock Coring
O = Other
Notes

Field G/C (Make/Mod)
G/C Oper.

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. <u>MUS-01</u>	Page <u>3</u> of <u>3</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site <u>3</u>
Project No. <u>W0121-06</u>	Client/Project: <u>HAWAII / Sky Harbor AFB</u>	
HAZWAP Contractor: <u>ITC (CERCLA)</u>	Drill Contractor: <u>LAWSON ENVIRONMENTAL</u>	Driller: <u>Dwight Peterson</u>
Drill Started: <u>3/22/91</u> (<u>8:30 A.M.</u>)	Drill Ended: <u>3/22/91</u> (<u>1:30 P.M.</u>)	Borehole dia(s): <u>10 3/4"</u>
Drill Method/Rig Type: <u>DUAL TUBE PERCUSSION</u>		
Logged by: <u>GARDNER</u>	E-Log: <u>(N)</u> From <u> </u> to <u> </u>	Protection Level: <u>D (MODIFIED)</u>



U = Thin Wall Tube
 S = Sp. (solid tube)
 O = Other

R = Rock Coring
 O = Other
 Notes

Field G/C (Make/Mod.)
 G/C Oper.

FIGURE S-3a

BORING LOG		BORING/WELL NO. MW3-02		REV. DATE MAY 99	
Installation Sky Harbor		Coordinates:		Page 1 of 3	
Project No. 40472602		Client/Project: HARWRAP / FT SH HARBOR ANG		Site 3	
HAZWRAP Contractor IT CORPORATION		Drill Contractor LAMME ENVIRONMENTAL		Driller GABBY RODRIGUEZ	
Drill Started 3/23/91 (0.25 m)		Drill Ended 3/24/91 (4.30 m)		Borehole dia(s) 10 3/4"	
Drill Method/Rig Type: Dual Tube Percussion					
Logged by GARDIN		E-Log Y (N) From to		Protection Level D (MODIFIED)	

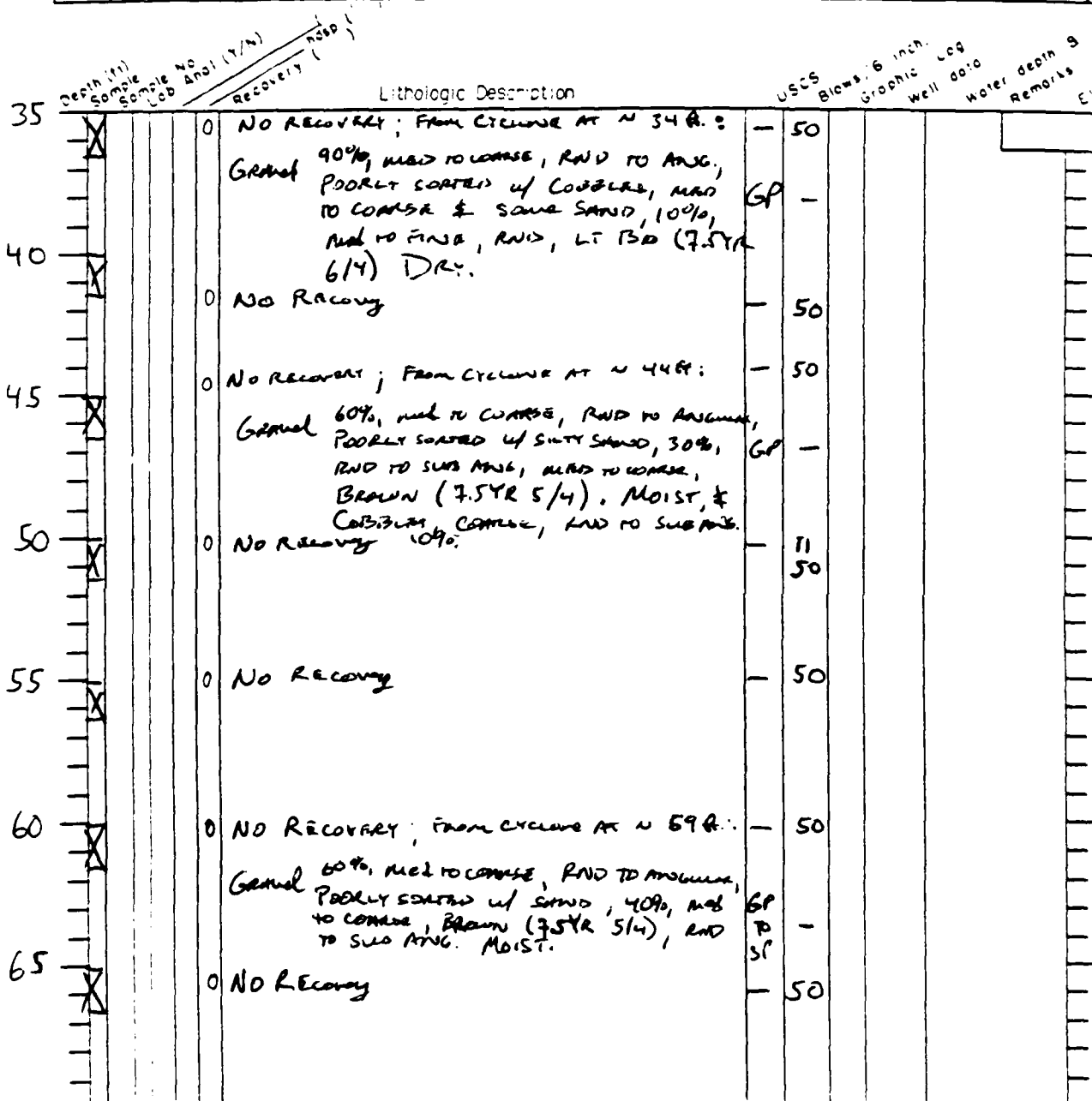
Depth (ft)	Sample No.	Sample Lab	Recovery (%)	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well Soil	Water Depth	Remarks
0										
0	Y	000		SAND 95%, MED TO FINE, RND TO SUB RND, DARK BROWN (7.5YR 3/3), MOSTLY WELL SORTED BUT w/ occasional GRAVEL, MED, RND. DRY.	SW	12				
5	Y	000		SAND 99%, MED F, RND TO SUB RND, BROWN (7.5YR 4/3), MOSTLY WELL SORTED w/ FINE GRAVEL, 1%, FINE, RND DRY.	SW	20				
10				No Recovery		32				
15				No Recovery		50				
20				GRAVEL 90%, MED TO COARSE, RND TO SUB RND, MED. POORLY SORTED w/ SAND, RND, MED TO COARSE, BROWN (7.5YR 4/3), RND TO ANG. DRY	GP	50				
25				No Recovery		50				
30				No Recovery		50				

U = Thin wall Tube	R = Rock Coring	Field G.C. (Make/Mod)
S = Split spoon tube	O = Other	G.C. Open
Notes		

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO	MWD-02		Page	2	of	3
Installation	Sky Harbor	Coordinates:	Site		3		
Project No.	40471	Client/Project	HAZWRAP / Sky Harbor ANG				
HAZWRAP Contractor	IT Corporation	Drill Contractor	LAWSON ENGINEERING		Driller	GABBY RODRIGUEZ	
Drill Started	3/23/91	(8 25 A.M.)	Drill Ended	3/23/91	(4 30 P.M.)	Borehole dia(s)	10 3/4"
Drill Method/Rig Type	Dual Tube Percussion						
Logged by	GARDIN	E-Log	Y	(N)	From	to	
					Protection Level	D (MODIFIED)	



U = Thin wall Tube	R = Rock Coring	File # G/C (Maker/Mod)
S = Split spoon (tube)	O = Other	G/C Oper
C = Casing	Notes	

REV DATE MAY 990

BORING LOG	BORING/WELL NO	MW3 - 02	Page	3	of	3
Installation	Sky Harbor	Coordinates:	Site	3		
Project No.	40421-01	Client/Project:	HAZURAR / Sky Harbor ANG			
HAZWRAP Contractor:	IT Corporation	Drill Contractor:	Layne Environmental	Driller:	GARY ROGERS	
Drill Started:	7/23/11 (8 25 A m)	Drill Ended:	7/23/11 (4 30 P m)	Borehole dia(s)	10 3/4"	
Drill Method/Rig Type:	DUAL TUBE PERCUSSION					
Logged by:	GARDIN	E-Log:	Y (N)	From	to	Protection Level:
						D (MODIFIED)

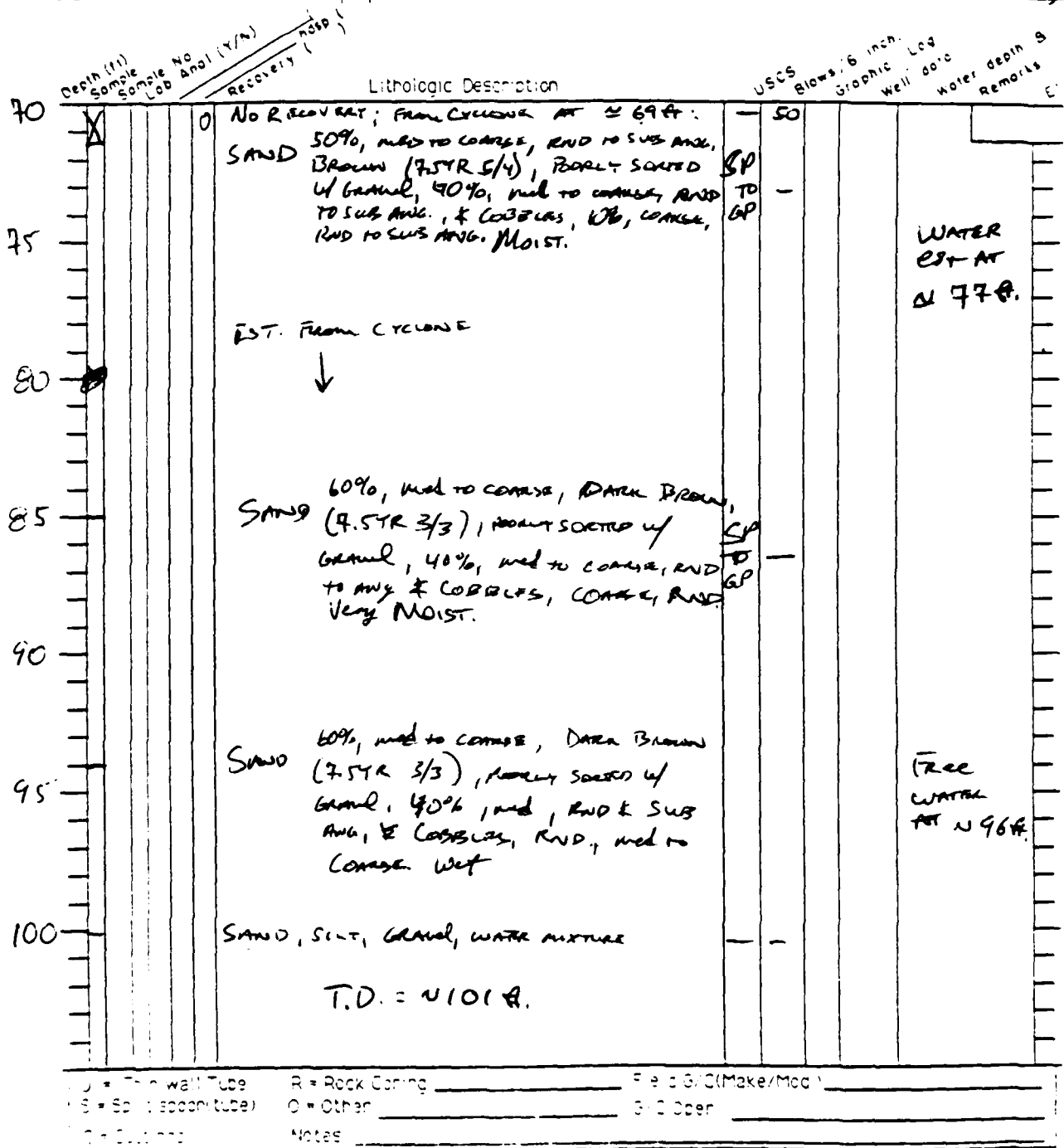


FIGURE 5-3a

REV DATE MAY 196

BORING LOG	BORING/WELL NO.: SB3-01	Page 1 of 2
Installation: Sky Harbor	Coordinates:	Site: 3
Project No.: 40172	Client/Project: HAZWAP / Sky Harbor ANG	
HAZWAP Contractor: ITC	Drig Contractor: LARSEN ENVIRONMENTAL	Driller: DUNN
Drig Started: 3/24/91 (8:40 a.m.)	Drig Ended: 3/24/91 (1:00 p.m.)	Borehole dia(s): 10 3/4"
Drig Method/Rig Type: Dual Tube Percussion		
Logged by: GARDNER	E-Log (Y/N) From to	Protection Level: D (Add)

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (ft)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
0										
0.00				SAND 99%, FINE, RND TO SUB RND, BROWN (7.5YR 5/4 TO 4/4), MOSTLY WELL SORTED BUT w/ < 1% G LT & FINE, RND GRAVEL.	SW	32				
						26				
						27				
5				No Recovery		50				
10				No Recovery		50				
15				No Recovery; from CYCLONE at 14-15 ft.		50				
20				SAND 55%, med to coarse, SUB ANG TO ANG, LT BROWN (7.5YR 6/4), POORLY SORTED w/ GRAVEL, 30% med to coarse, RND TO ANGULAR, & COBBLES, COARSE, RND TO SUB ANGULAR. Dry	SP TO GP					
				No Recovery		50				
25				No Recovery		50				
30				No Recovery		50				

U = Thin wall Tube
S = Split spoon (tube)
C = Casing

R = Rock Coring
O = Other
Notes:

Field G/C (Make/Mod.)
G/C Oper.:

FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO.: <u>AT SB3-01</u>	Page <u>2</u> of <u>2</u>
Installation: <u>Sky Harbor</u>	Coordinates:	Site: <u>3</u>
Project No.: <u>400011-01-02</u>	Client/Project: <u>HAZWRAP/Sky Harbor ANG</u>	
HAZWRAP Contractor: <u>IT Corporation</u>	Drig Contractor: <u>Layne Environmental</u>	Driller: <u>Donner Peterson</u>
Drig Started: <u>3/24/91</u> (B: <u>40 A m</u>)	Drig Ended: <u>3/24/91</u> (B: <u>00 P m</u>)	Borehole dia(s): <u>10 3/4"</u>
Drig Method/Rig Type: <u>Down Tube Percussion</u>		
Logged by: <u>Gardner</u>	E-Log (Y/N) <u>(N)</u> From <u> </u> to <u> </u>	Protection Level <u>D (MODIFIED)</u>

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
35	X			0 No Recovery; From Cyclone at ~ 34 ft: SAND 60%, med to coarse, RND to angular, LT. Brown (7.5 YR 6/4), POORLY SORTED w/ gravel, 30%, med to coarse, RND to sub ang, & cobbles, 10%, RND to sub ang. DRY.	-	50				
40	X			100 No Recovery	-	50				
45	X			0 No Recovery; From Cyclone at ~ 44 ft:	-	50				
50	X			SAND 51%, coarse, med to coarse, DARK BROWN (7.5 YR 3/3), POORLY SORTED w/ some silt, 5%, & gravel, 30%, med to coarse, RND to sub ang, & cobbles, 15%, RND, coarse. MOIST ODOR	SP TO GP	-				
55	X			40 SAND 60%, med to coarse, ANG to sub RND, DARK BROWN (7.5 YR 3/3), POORLY SORTED w/ silt, 3%, & gravel, 30%, RND, med to coarse, & cobbles, 5%, RND, coarse. MOIST. Very slight odor	SP	27 50				
60	X			0 No Recovery	-	29 50				
65	X			30 No Recovery	-	50				
70	X			80 No Recovery No Recovery At 70 ft. = From Cyclone at 67-70: 63%, med to coarse, RND to sub ang, SAND Dark Brown (7.5 YR 3/3 to 4/3), POORLY SORTED w/ gravel, 30%, med to coarse RND to sub ang, & cobbles, 10%, coarse, RND	SP TO GP	-				Very moist & muddy shale odor of solvent.

U = Thin Wall Tube
S = Split spoon (tube)

R = Rock Coring
O = Other

TD = 20 ft

Field G/C (Make/Mod.)

G/C Oper.

C = Cuttings

Notes

22 SX Cement
3 SX Mud

FIGURE 5-3a

REV. DATE MAY 199

BORING LOG	BORING/WELL NO: SB3-03	Page 1 of 2
Installation: Sky Harbor	Coordinates:	Site: 3
Project No: 40421-06	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drig Contractor: LAYNE Environmental	Driller: Duane Patterson
Drig Started: 3/25/91 (11:45 A.M.)	Drig Ended: 3/25/91 (4:30 P.M.)	Borehole dia(s): (0.75")
Drig Method/Rig Type: Dual Tube Percussion		
Logged by: GARDINER	E-Log (Y/N) (N)	From _____ to _____
		Protection Level: D (Modified)

Depth (ft)	Sample No	Lab Anal. (Y/N)	Recovery	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth	Remarks
0										
0.50	Y			SAND 80%, med to coarse, RND to SUB ANG, Brown (7.5R 5/4), poorly sorted w/ gravel, 20%, med to fine RND. Slightly moist.	SP	22				
						25				
						34				
5										
0.50	Y			SAND 70%, med to coarse, RND to SUB ANG, Brown (7.5R 5/4), poorly sorted w/ gravel, 20%, med to coarse, RND to coarse, 10%, med to coarse, RND	SP	25				
						50				
10										
0.90	Y			SAND 80%, med to coarse, RND to SUB ANG, Dark Brown (7.5R 3/3), poorly sorted w/ gravel, 20%, med to coarse, RND to SUB RND. Slightly moist	SP	22				
						32				
						50				
15				0 No Recovery		50				
20										
0.50	Y			SAND 70%, med to coarse, RND to SUB ANG, Brown (7.5R 4/3), poorly sorted w/ gravel, 20%, med to coarse, ANG to SUB RND, 2 coarse, 10%, RND, coarse	SP	18				
						24				
						31				
25				0 No Recovery		50				
30				0 No Recovery		50				

U = Thin wall Tube
S = Split spoon (tube)
C = Cuttings

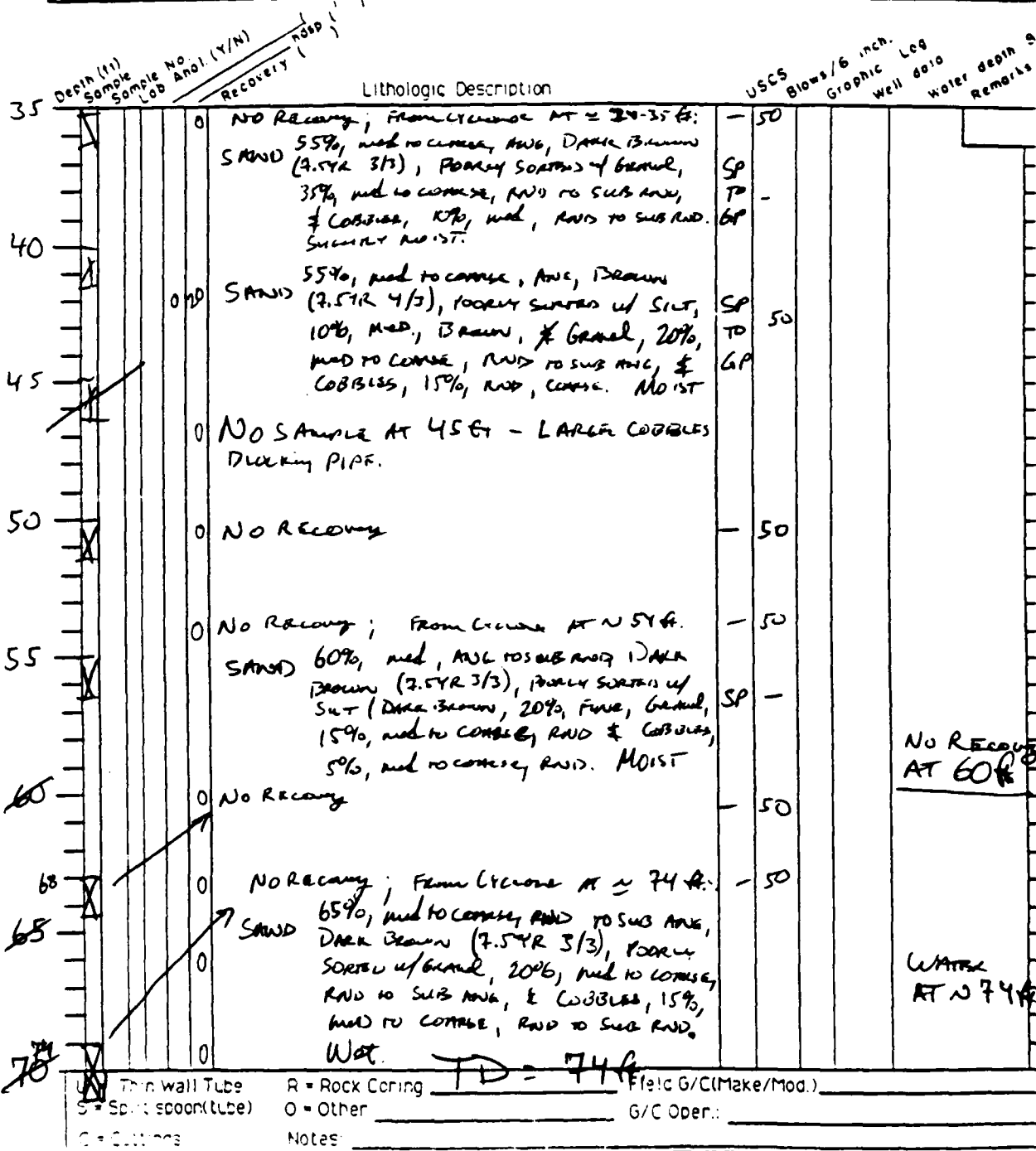
R = Rock Coring
O = Other
Notes:

Field G/C (Make/Mod.)
G/C Oper.:

FIGURE 5-3a

REV DATE MAY 19C

BORING LOG	BORING/WELL NO.: SB3-03	Page 2 of 2
Installation: Sky Harbor	Coordinates:	Site: 3
Project No.: 404921.02	Client/Project: HAZWRAP / Sky Harbor Airg	
HAZWRAP Contractor: ITC Corporation	Drig Contractor: LARME Environmental	Driller: DAUGHT PETERSON
Drig Started: 3/25/91 (11:45 A.M.)	Drig Ended: 3/25/91 (4:30 P.M.)	Borehole dia(s): 10 1/4"
Drig Method/Rig Type: DIRT TUBE PRESSURE		
Logged by: GARDINER	E-Log (Y/N): (N)	From _____ to _____
Protection Level: D (MODIFIED)		



26 SK Cement

4 SK Bentonite Powder

FIGURE 5-3a

REV. DATE MAY 199

BORING LOG	BORING/WELL NO.: SB3-04	Page 1 of 2
Installation: Sky Harbor	Coordinates:	Site: 3
Project No.: 401-11-02	Client/Project: HAZWRAP / Sky Harbor Ave	
HAZWRAP Contractor: IT Corporation	Drill Contractor: LANE ENVIRONMENTAL	Driller: DUNCAN PATTERSON
Drill Started: 3/24/91 (2:00 P.M.)	Drill Ended: 3/25/91 (11:00 A.M.)	Borehole dia(s): 10 3/4"
Drill Method/Rig Type: Deep Tube Percussion		
Logged by: GARDNER	E-Log (Y/N) From _____ to _____	Protection Level: D (MODIFIED)

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well depth	Water depth	Remarks
0										
1	Y			97%, FINE, RND, DARK BROWN (7.5YR 3/5 to 4/5), mostly well sorted w/ minor silt & rare gravel, fine, rnd. Slightly moist	SW	10				
2						19				
3						14				
5	Y			100%, med to coarse, RND to sub ang, Brown (7.5YR 5/3), well sorted. Slightly moist.	SW	14				
6						25				
7						29				
10	X			75%, med to coarse, RND to sub ang, Brown (7.5YR 5/3), poorly sorted w/ gravel, 20%, med to coarse, RND to sub ang & gravel, 5%, med to coarse, RND. Dry.	SP	50				
15	X			80%, med, RND to sub ang, Brown to dark brown (7.5YR 4/3), poorly sorted w/ gravel, 20%, med to coarse, RND to sub ang, & occasional cobbles, coarse, RND. Dry	SP	50				
20	X			60%, med to coarse, sub RND to ang, Brown (7.5YR 5/3), poorly sorted w/ gravel, 30%, med to coarse, RND to sub ang & cobbles, 10%, med to coarse, RND to sub ang. Dry	SP	50				
21						78				
22						61				
25	X			0 No Recovery	-	50				
30	X			0 No Recovery	-	50				

U = Thin wall Tube
S = Spoon (tube)
C = Castings

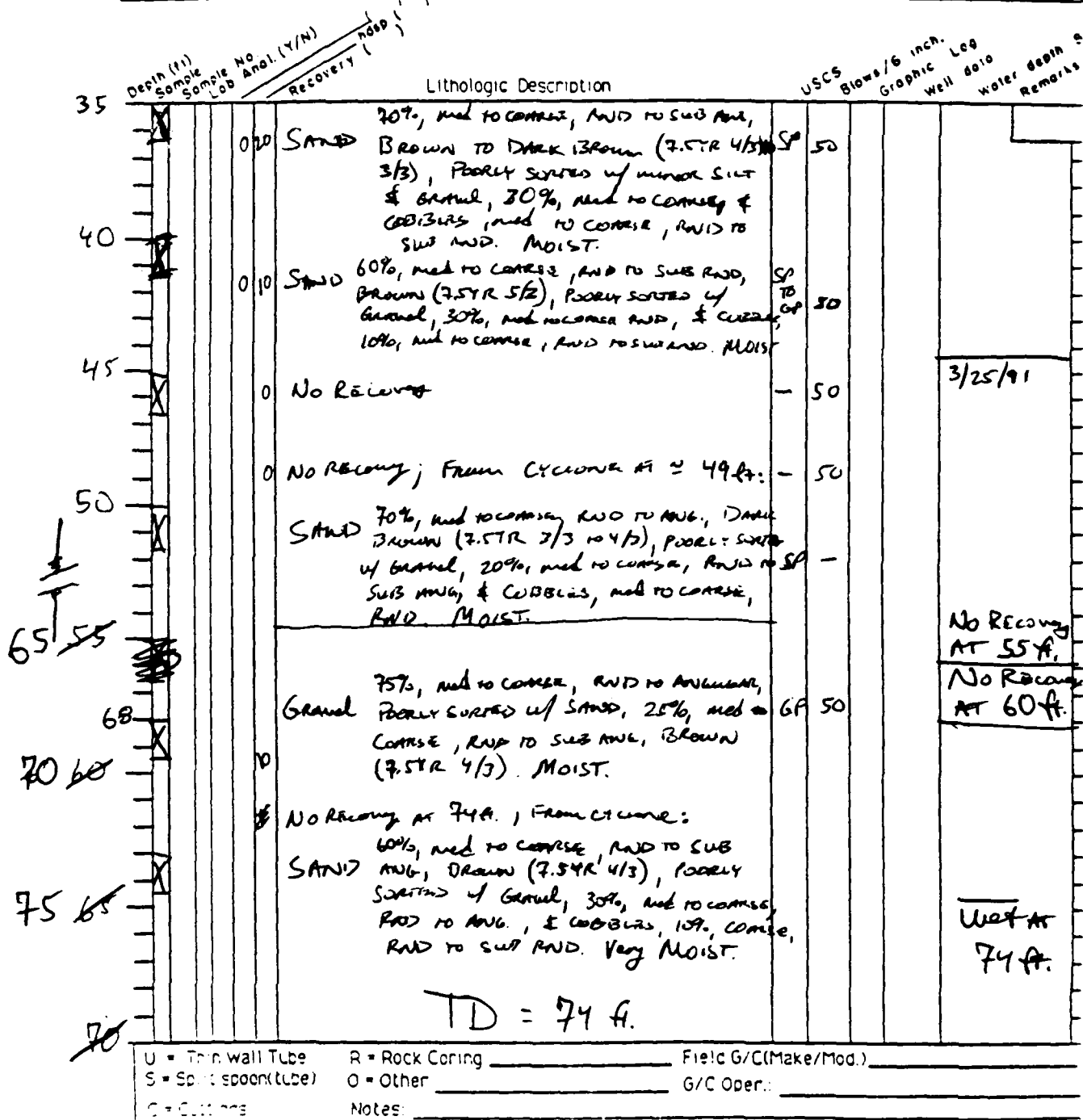
R = Rock Coring
O = Other
Notes

Field G/C (Make/Mod.)
G/C Oper.

FIGURE 5-3a

REV DATE MAY 199

BORING LOG	BORING/WELL NO.: SB3-04	Page 2 of 2
Installation Sky Harbor	Coordinates:	Site: 3
Project No.: 40421-02-06	Client/Project: HAZWRAP / Sky Harbor AN6	
HAZWRAP Contractor: T Corporation	Drig Contractor: LANE Environmental	Driller: DUNCAN
Drig Started: 3/24/91 (200 P m)	Drig Ended: 3/25/91 (11:00 A m)	Borehole dia(s) 10 3/4"
Drig Method/Rig Type: DUNE TUBE PERCUSSION		
Logged by: GARNON	E-Log (Y (N)) From to	Protection Level: D (MODIFIED)



22 SK Count
3 SK AND

FIGURE 5-3a

BORING LOG	BORING WELL NO	MW5-01		REV. DATE MAY 1990
Installation	Sky Harbor	Coordinates:	Site	5
Project No	40721-01	Client/Project	HAZWRAP/Sky Harbor ARN	
HAZWRAP Contractor	IT Corporation	Drill Contractor	Layne Environmental	Driller
Drill Started	2/2/91	Drill Ended	2/2/91	14:00 - 1 mi
Drill Method/Rig Type	Air Hammer Casing	Borehole dia	9 3/4"	
Logged by	GARDINER	E-Log	(N)	From _____ to _____
		Protection Level	D (MODIFIED)	

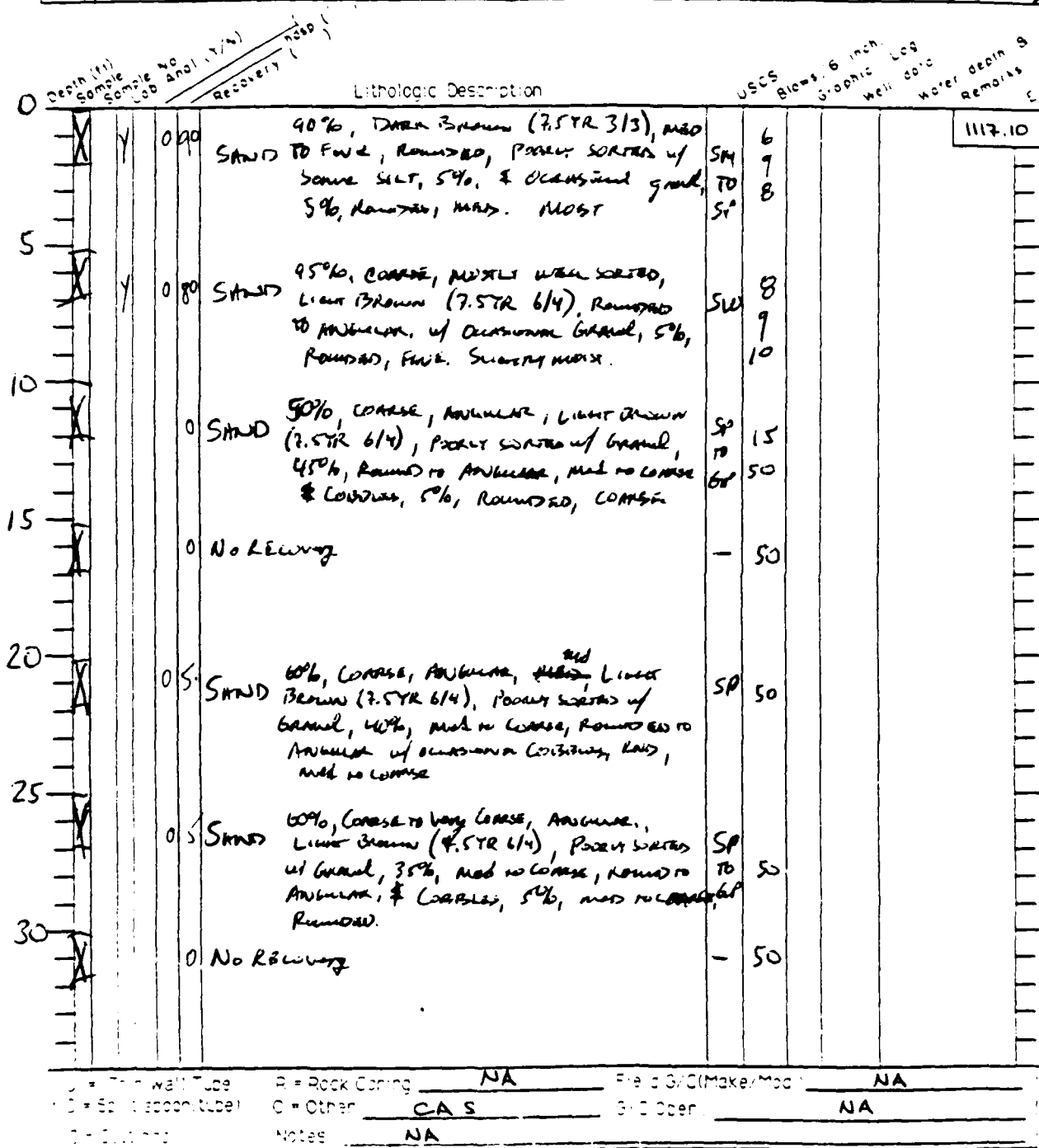


FIGURE S-3a

BORING LOG	BORING WELL NO. MW5-01	REV. DATE MAY 1997
Site at Sky Harbor	Coordinates:	Site 5
Project No. 40174.026	Client/Project: HAZWAP / Sky Harbor Area	
HAZWAP Contractor: IT Corporation	Drill Contractor: LORAIN ENVIRONMENTAL	Dr. en: DARY LINDA
Drill Started: 2/2/91	Drill Ended: 2/14/91	Borehole dia: 9 3/4"
Drill Method/Rig Type: Air Hammer Casing		
Logged by: GARDNER	E-log: (N) From: to:	Protection Level: D (MODIFIED)

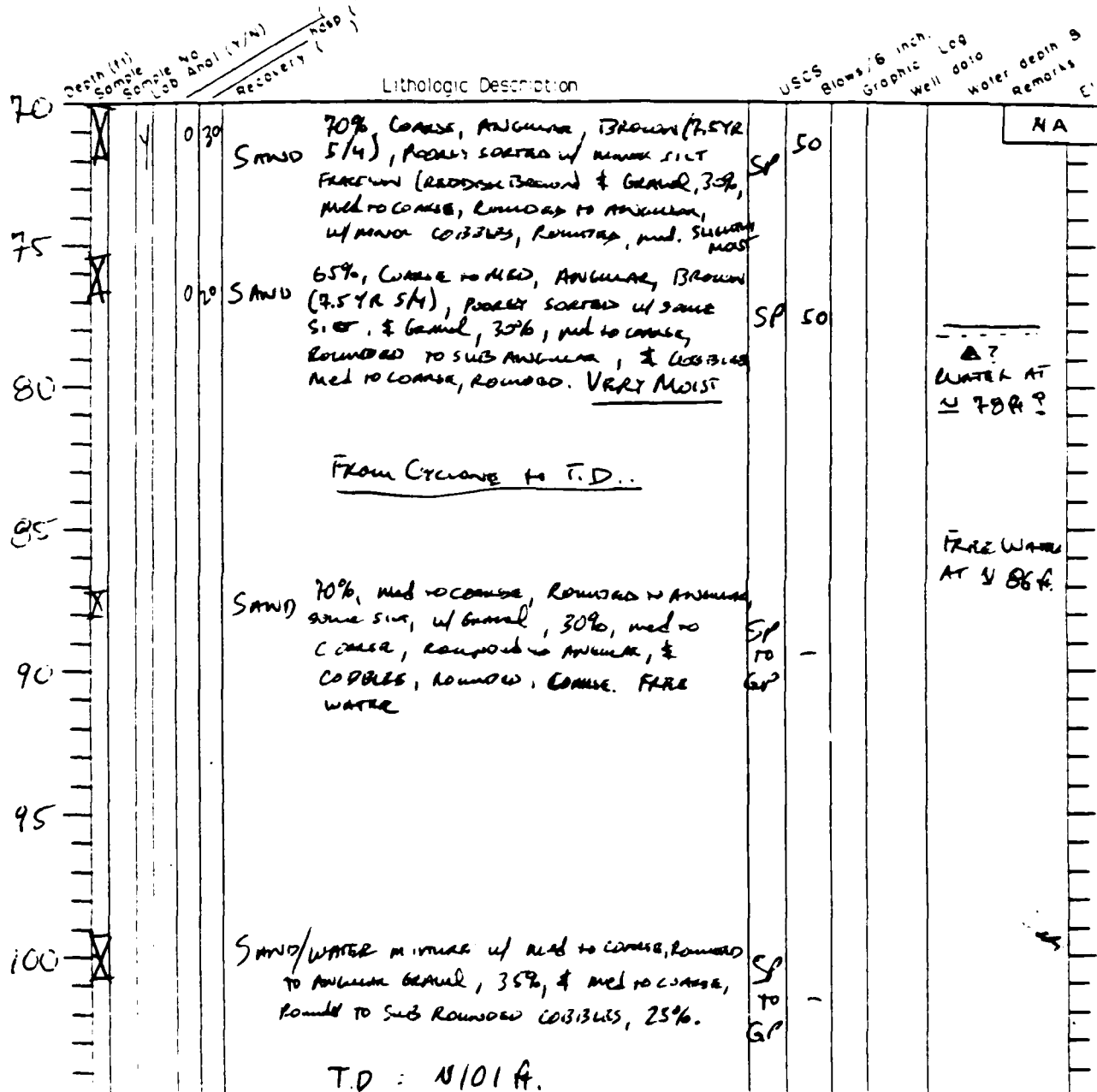
Depth (ft)	Sample No.	Sample Label	Recovery (%)	Lithologic Description	USCS	Blows, 6 inch	Graphic Log	Well depth	Water depth	Remarks
35	0			No Recovery		50				NA
40	0			No Recovery; From casing at CA 39A.1: 65% coarse, angular to sub rounded, SAND, poorly sorted (7.5 to 5/4), poorly sorted w/ gravel, 30%, and no coarse, rounded to angular & cobbles, 5%, very coarse, rounded to sub angular. <u>MOIST</u>	SP TO GP	50				
45	0			65% coarse rounded, angular to sub rounded, poorly sorted w/ a minor silt fraction & gravel, 30%, and no coarse, rounded to angular, & cobbles. (7.5 to 5/4) <u>MOIST</u>	SP TO GP	50				
50	0			No Recovery		50				
55	0			75% coarse, angular, poorly sorted (7.5 to 5/4), poorly sorted w/ gravel, 25%, and no coarse, rounded to angular, & cobbles (rare), coarse, rounded. <u>VERY MOIST</u>	SP	50				
60	0			70% coarse, angular, poorly sorted w/ gravel & cobbles, 30%, and no coarse, rounded to sub angular. <u>VERY MOIST</u>	SP	24 20 30 18				
65	0			No Recovery		50				

1 = Thin wall tube	P = Rock Casing	NA	Field CMake Mod	NA
2 = Split spoon sampler	O = Other	CAS	3 = Open	NA
3 = Solid core	Notes	NA		

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO	MWS-01	Page	3	of	3	
Installation	Sky Harbor	Coordinates:	Site	5			
Project No	40971.02.06	Client/Project	HABWRAP / Sky Harbor ANG				
HABWRAP Contractor	IT Construction	Drill Contractor	LOVE ENGINE CONSTRUCTION	Driller	DREY LODGE		
Drill Started	2/7/91	0830 A.M.	Drill Ended	2/7/91	1400 P.M.	Borehole dia(s)	9 3/4"
Drill Method/Rig Type	AIR Hammer Casing						
Logged by	Gardner	E-Log	N	From		to	
						Protection Level	D(MODIFIED)



1 = Thin wall Tube	R = Rock Coring	NA	Field S/C (Maker/Mod)	NA
2 = Sp. Spoon Tube	O = Other	CA S	S/C Open	NA
3 = Split Spoon	Notes	NA		

BORING LOG		BORING/WELL NO.: PP-01		REV DATE MAY '990
Installation: PAPA Military Reservation, Phoenix, AZ		Site: PAPA		Page 1 of 2
Project No. 406221.02		Client/Project: HAZWRAP/SKHARBOX ARV		
HAZWRAP Contractor: IT Corporation		Drig Contractor: LAMAR Environmental		Driller: GARDNER
Drig Started: 1/19/91 () m		Drig Ended: () m		Borehole dia(s): 6" TO START 10" TO FINISH
Drig Method/Rig Type: AIR ROTARY HAMMER				
Logged by: GARDNER		E-Log (Y/N) From _____ to _____		Protection Level D (REQUIRED)

Depth (ft)	Sample No	Sample Lab	Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well depth	Water depth	Remarks
0					5ft SAND, RED BROWN (2.5R 4/4), MEDIUM TO COARSE GRAINED w/ SMALL GRAVEL. POOKY SORTED & GRADED.	SP					1245.52
10					10ft CALICHE - WHITISH PINK, FINELY POWDERED FROM REG. MIXED w/ REDDISH BROWN SAND & SMALL GRAVEL (5%)						
20					15ft SAND, with some CALICHE; SAND is POOKY SORTED, MEDIUM TO COARSE, RED BROWN (2.5R 4/4) w/ SMALL GRAVEL (ABUNDANT).	SP					
30					24ft GRAVEL VOLCANIC ROCK (2.5R 4/4), RED BROWN w/ 2-5mm BRECCIA (2-5mm); MOSTLY QUARTZITE.						
40					25ft GRAVEL VOLCANIC ROCK (2.5R 4/4), RED BROWN w/ QUARTZITE & OTHER BRECCIA FRAGMENTS w/ 2-5mm 1st & ANGIOLIN NEXT TO WEST?						
50					30ft GRAVEL VOLCANIC ROCK (2.5R 5/4); RED BROWN, BUT LIGHTER IN COLOR GAIN w/ ANGIOLIN BRECCIA FRAGMENTS.						
60					35ft GRAVEL VOLCANIC ROCK (2.5R 5/4); RED BROWN, w/ 3-10mm BRECCIA FRAGMENTS (ABUNDANT).						
70					40ft GRAVEL VOLCANIC ROCK (2.5R 5/4); RED BROWN w/ 3-5mm ANGIOLIN BRECCIA FRAGMENTS.						
80					45ft GRAVEL VOLCANIC ROCK (2.5R 5/4); RED BROWN w/ 2-5mm ANGIOLIN BRECCIA FRAGMENTS.						
90					49-50ft GRAVEL VOLCANIC ROCK, GRAY (5R 7/1) w/ ANGIOLIN 1-3mm BRECCIA FRAGMENTS.						

U = Thin Wall Tube R = Rock Coring NA Field G/C (Make/Mod.) NA
 S = Split spoon (tube) O = Other CA S G/C Oper.: NA
 C = Cuttings Notes: NA

FIGURE 5-3a

BORING LOG		BORING/WELL NO. PP-01		REV DATE MAY 1990	
Installation Sky Harbor		Coordinates:		Page 2 of 2	
Project No. 40974-02.00		Client/Project: HAZWAP/Sky Harbor Ark		Site: PAPAGO (S&P)	
HAZWAP Contractor: IT Corporation		Drill Contractor: Lowe Environmental		Driller: G. M. Lyons	
Drill Started: 1/20/91 (10:05 A.M.)		Drill Ended: 1/20/91 (12:30 P.M.)		Borehole dia(s): 10"	
Drill Method/Rig Type: Air Rotary Hammer					
Logged by: G. M. Lyons		E-Log (Y/N) (N)		From _____ to _____	
Protection Level: D (modified)					

Depth (ft)	Sample No.	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well dia	Water depth	Remarks
50				<p><u>50ft.</u> Returns to Ground Red Brown Volcanic Rock (2.5 YR 5/4) w/ 2-5 mm Angular Breccia Fragments (10%)</p>						NA
60				<p><u>55ft.</u> Ground Volcanic Rock, Very Dark Red (10 YR 3/6) w/ 2-5 mm Angular Breccia Fragments (10-15%)</p>						
65				<p><u>59 ft.</u> Ground Volcanic Rock, Red Brown (2.5 YR 4/4) w/ 2-5 mm Angular Breccia Fragments (10-15%) TD = 59' 4" TO BE FURTHER ADVANCED - 1/20/91</p>						
				<p><u>65ft.</u> Red Brown Volcanic Rock with 2-10 mm Angular Volcanic Breccia Fragments (20-25%) TD = 65' 0"</p>						

U = Thin Wall Tube	R = Rock Core	NA	Field G/C (Make/Model)	NA
S = Solid Spoon Tube	O = Other	CA S	G/C Oper	NA
Notes	NA			

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO	PP-02	Page 1 of 1
Installation: Sky Harbor	Coordinates:	Site: PARALO (4)	
Project No. 40174.02	Client/Project: HAZWRAP / Sky Harbor AVB		
HAZWRAP Contractor: IT Corporation	Drig Contractor: LATWA	Driller: Gary Lyons	
Drig Started: 1/19/91 (0845 a.m.)	Drig Ended: 1/19/91 (6:30 p.m.)	Borehole dia(s): 10"	
Drig Method/Rig Type: Air Rotary Hammer			
Logged by: Gordon	E-Log (Y/N) ()	From _____ to _____	Protection Level: D (Maximal)

Depth (ft)	Sample No	Sample Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows / 6 inch	Graphic Log	Well data	Water depth	Remarks
0				0-3 Gravel of some sand (U 10%). Coarse, angular, light reddish brown (5YR 6/4).	GP					1251.37
10				3-5 Gravel, w/ 20% sand, light brown (7.5YR 6/4).	GP					
20				10ft. Calcic; yellow to buff w/ some quartzite & other angular pieces. Fine gravel with crushes. 20ft. Buff to gray, calcic or other powder: rock w/ some (1-3mm) angular fragments of basalt. (2.5Y 7/4) Some gravel - well rounded.						
30				30ft. Stone buff gravel rock. Hard (possibly not calcic). Some pinkish, (4.5YR 7/4). Some angular fragments						
40				31ft. Thinly red. 40ft. Ground volcanic rock, (5YR 6/4) Light reddish brown, softer at 30ft. Some angular 2-5mm basaltic fragments. Maximum water					Water at 38 to 40ft	
50				50ft. Ground volcanic rock, reddish brown (2.5YR 5/4). Some 2-5mm angular basaltic fragments (ca. 10%).						
60				55ft. Ground volcanic rock, reddish brown (2.5YR 5/4), w/ some 2-5mm angular basaltic fragments (ca. 10%). TD: 55ft.						

U = Thin wall tube	R = Rock Coring	NA	File # G/C (Make/Mod)	NA
B = Split spoon tube	O = Other	NA	G-C Open	NA
C = Casing	Notes	NA		

BORING LOG		BORING/WELL NO.: PP-3		REV. DATE: MAY 1990
Installation: SKT PAPAGO MOUNTAIN RESERVATION		Page 1 of 2		
Project No.: 401921.02.01		Client/Project: MARTIN MARICOTA / SKT HANCOCK AVE		
HAZWRAP Contractor: IT Corporation		Drig Contractor: LAYNE ENVIRONMENTAL Driller: DWIGHT PERKINS		
Drig Started: 1/13/91 (12:55 PM)		Drig Ended: 1/19/91 (09:30 AM)		Borehole dia(s): 10 6 INCHES
Drig Method/Rig Type: AIR PERCUSSION / AIR ROTARY				
Logged by: GARDNER		E-Log (Y/N) From _____ to _____		Protection Level: D (MODIFIED)

Depth (ft)	Sample No	Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks	Elev.
0				0-10 ft: SAND, POORLY SORTED, POORLY GRADED w/ GRAVEL & FINES. HUE 7.5YR 6/3 LIGHT BROWN & DRY. AT 10 ft w/ VERY FINE POWDERED ROCK - PROBABLY CALICHE. - FROM SIX FEET ON. 5YR 10ft: CALICHE. (FINE POWDER & COARSE 7/2 FRAGMENTS - WHITE TO BUFF, IN ON CRYSTALLINE)	SP						1239.72
10				10-20 ft. (N 12-14 ft - w/ SAND & GRAVEL; 14 ft: w/ FINE GRAINED SAND w/ SMALL GRAVEL, DARK REDDISH BROWN, 2.5 YR 3/3 RUN IN w/ ROTARY RIG: 1/19/91/0845							
20				VOLCANIC ISOLATION - RED BROWN (2.5YR 4/4); GRAVEL FROM SAND GRAVEL COMPONENT ARE MOSTLY QUARTZITE.							
30				SUGGEST DARKER - VERY SLIGHTLY MIX.							
40				40 ft RED BROWN (2.5YR 4/4) VOLCANIC ISOLATION w/ 2-5 mm SIZED QUARTZITE & OTHER GREEN CHIPS.							
50				55 ft. RED BROWN (2.5YR 4/4) VOLCANIC ISOLATION w/ 2-5 mm SIZED QUARTZITE & OTHER GREEN CHIPS. STARTING AT 54-55 ft							
				FD = 55 ft. 3 inches							

U = Thin Wall Tube	R = Rock Coring	NA	Field G/C (Make/Mod.)	NA
S = Split spoon (tube)	O = Other	NA	G/C Oper.:	NA
C = Cuttings	Notes:	NA		

FIGURE 5-3a

REV DATE MAY 1990

BORING LOG	BORING/WELL NO. PP-03	Page 2 of 2
Installation: Sky Harbor	Coordinates:	Site: Papaga
Project No.: 49721	Client/Project: Martin Marietta / Sky Harbor ANG	
HAZWRAP Contractor: IT Corp	Drig Contractor: Layne Env.	Driller: Dwight Peterson
Drig Started: See 1 of 2 () m)	Drig Ended: See 1 of 2 () m)	Borehole dia(s):
Drig Method/Rig Type: See 1 of 2		
Logged by: Gordiner	E-Log (Y/N) (N)	From to Protection Level: D (Mod. G.C.)

Depth (ft) Sample Lab Anal. (Y/N)	Recovery (%)	Lithologic Description	USCS	Blows/6 inch	Graphic Log	Well data	Water depth	Remarks
50		CONTINUE FROM 55 ft. CUTTING - CONCRETE DRILL FROM DRILL HOLE. NO EVIDENCE OF TRACINGS BIT.						NA
60		RED BROWN Ground Volcanic Rock (2.5R 4/4), w/ small 2-5 mm Angular BRECCIA FRAGMENTS. MOIST						
70		RED BROWN Ground Volcanic Rock (2.5R) w/ small 2-5 mm Angular BRECCIA FRAGMENTS. DRY.						
		TD = 70 ft. ^{11/2} 71 ft. ²³ 6						

J = Thin wall Tube	R = Rock Coring	Field G/C (Make/Mod.)
S = Sp. Spoon (tube)	O = Other	G/C Oper.
C = Casing	Notes	

FIGURE 5-32

REV. DATE MAY 1996

BORING LOG	BORING/WELL ID	MW4-61	
Project No.	Client/Project	4 (Pipes)	
HAZWRAP Contractor	HAZWRAP/SAFETY HAZARD ANALYSIS	Orig Contractor	LAURENCE ENVIRONMENTAL
Orig Started	2/1/91 43.15 p.m.	Orig Ended	2/1/91 4530 p.m.
Orig Method/Rig Type	AIR ROTARY HAMMER CASING	Driller	GARY LYONS
Logged by	GARDIN	E-Log (Y/N)	(Y)
From		to	
Protection Level		D (MODERATE)	

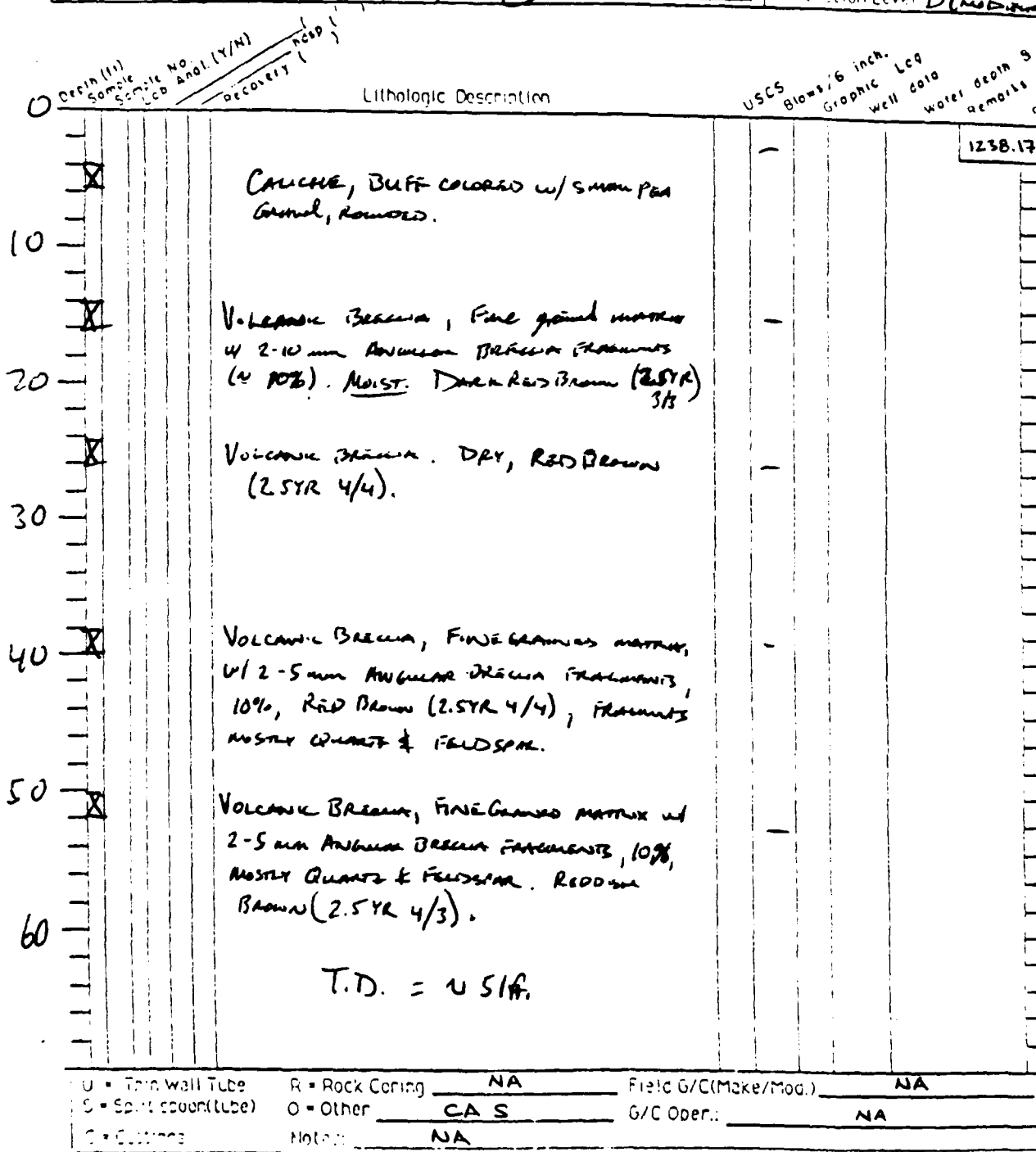
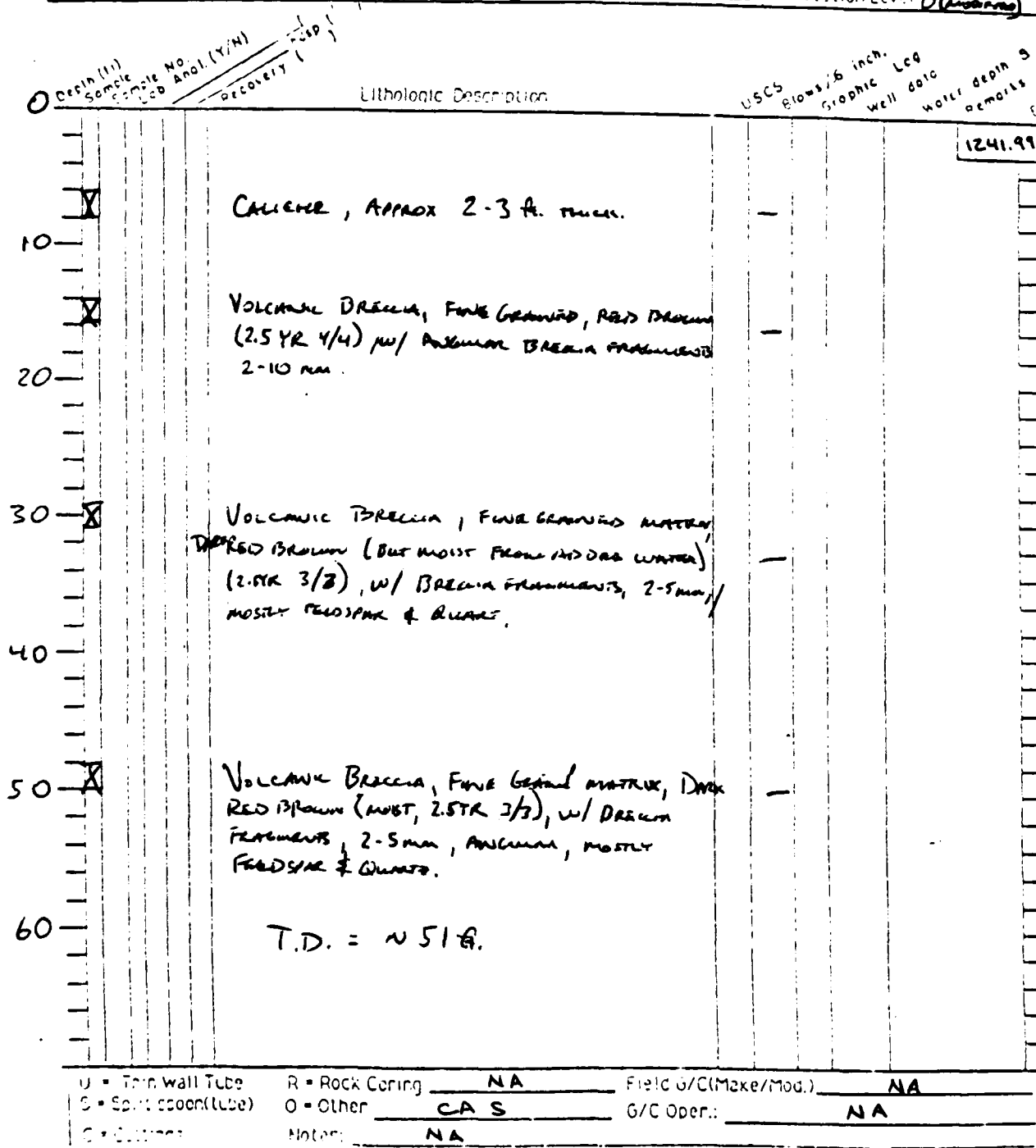


FIGURE 5-3

REV DATE MAY 1992

BOREHOLE LOG	BOREHOLE/WELL NO.	MAY-02		Page 1 of 1
Project No.	40921.02.06	Client/Project	HAZWRAP / SET HAZWRAP AUG	
HAZWRAP Contractor	IT Corporation	Drill Contractor	Lowe Environmental	Driller
Drill Started	2/1/91 01:00 AM	Drill Ended	2/1/91 12:00 PM	Borehole dia(s)
Drill Method/Rig Type	Air Rotary Hammer Core			
Logged by	Gordon	E-Log (Y/N)	(X)	From
				to
				Protection Level
				D (unknown)



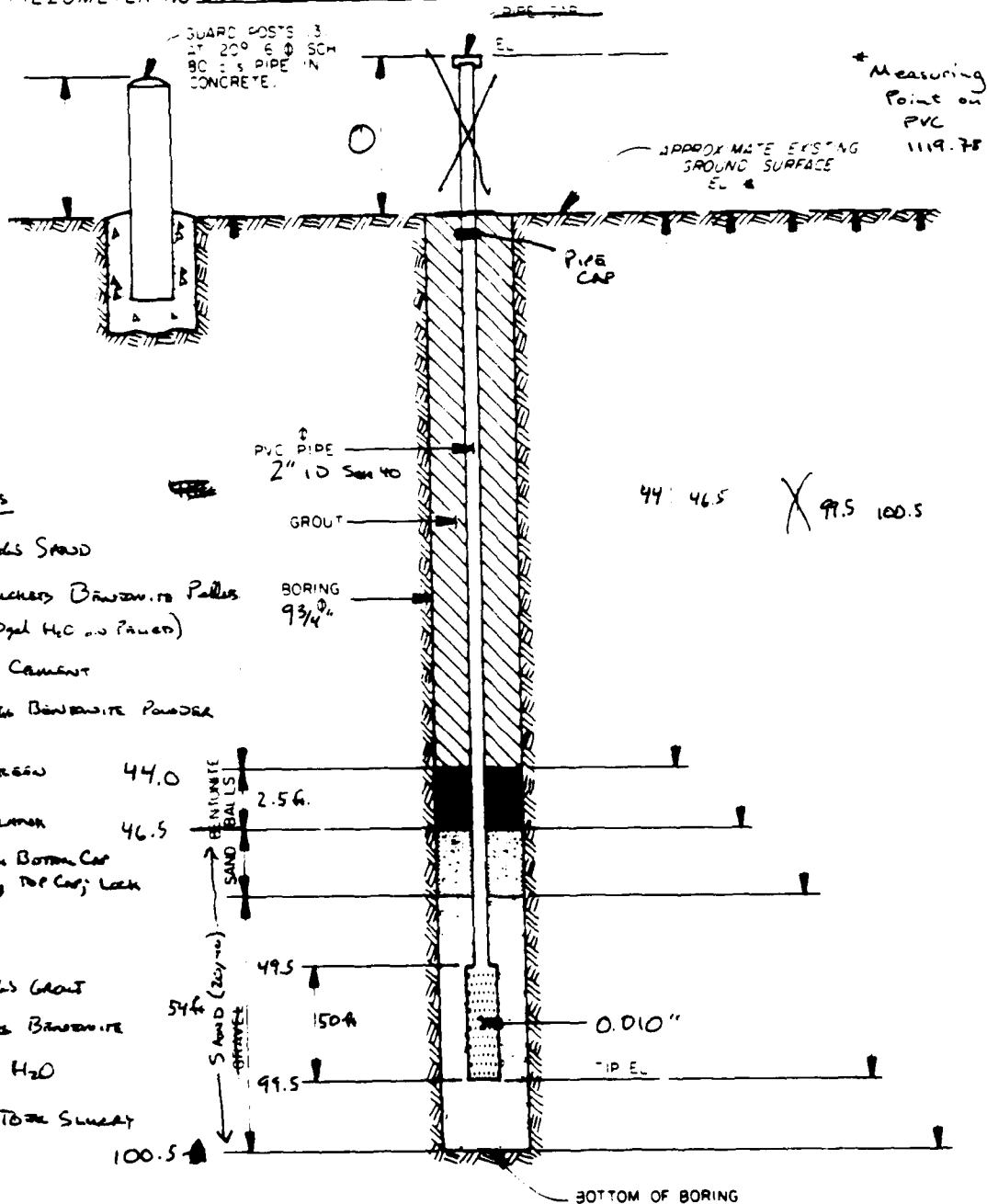
APPENDIX F

**PIEZOMETER AND MONITORING WELL
COMPLETION DIAGRAMS**



PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor Area INSTALLED BY Gardner DATE 11/15/91
PROJECT NO 409721.02.06 CHECKED BY NA DATE NA
BORING NO NA
PIEZOMETER NO SH #1 (PS-1)

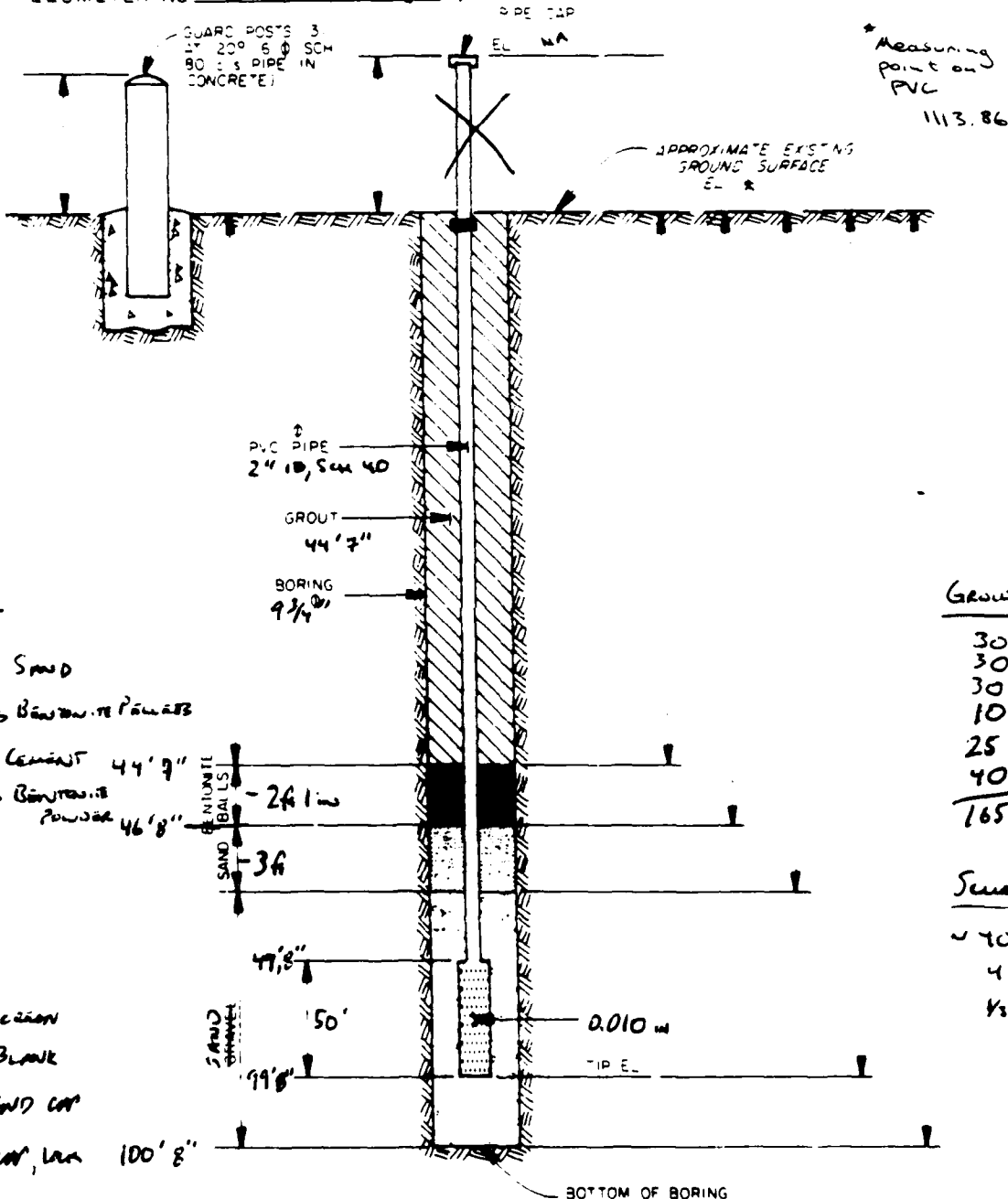


NOT TO SCALE



PIEZOMETER INSTALLATION SKETCH

PROJECT NAME SH ANG INSTALLED BY GARDNER DATE 1/16/91
 PROJECT NO 409721.02.06 CHECKED BY NA DATE NA
 BORING NO SH P-2
 PIEZOMETER NO SH Piezometer #2 (PS-2)



MATERIALS

2 1/2 Bags Sand
 1 1/2 Bags Bentonite Powder
 12 Bags Cement 44' 7"
 1 1/2 Bags Bentonite Powder 46' 8"

GROUT
 30
 30
 30
 10
 25
 40
 165 gal

COSTS

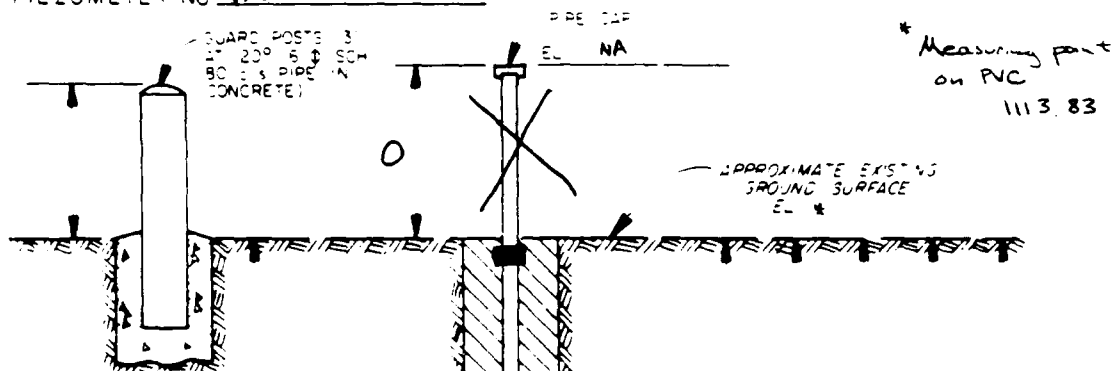
50 ft Section
 50 ft. Blank
 1 - 4 in. ID CAP
 1 - TOP CAP, 1 in. 100' 8"

Summary
 ~ 70 gal
 40 gal
 1/2 in. 2



PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sgt. H. J. ANG INSTALLED BY Greenlee DATE 1/16/91/1/17/91
PROJECT NO 401721.0206 CHECKED BY NA DATE NA
BORING NO PS-3
PIEZOMETER NO #3



MATERIALS

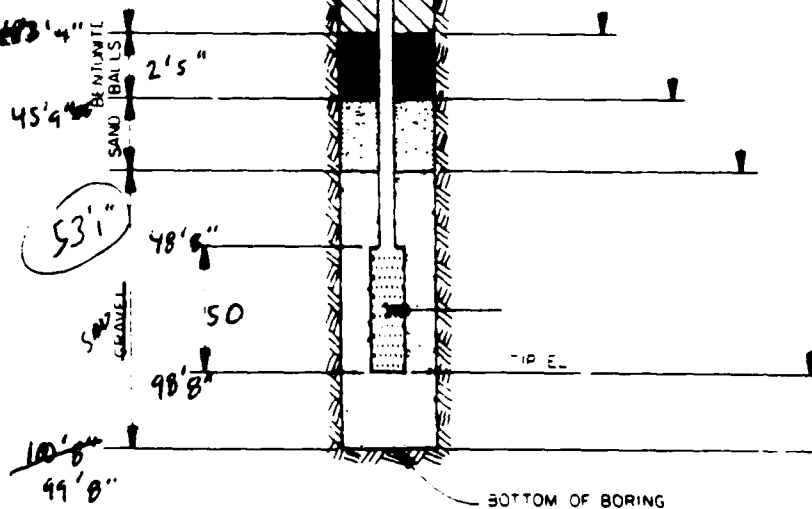
SAND. 23 1/2 bags

Bentonite: 2 bags

Water: 10 gal

33 BT Bags Cement

4 BT Bags Bentonite



Casing

50 ft. Screen

50 ft. Blank

1- 4 in. FWD CAT

1- 1 Lb. Lg. TOP CAT, Lg. Lg.

Top of
Pipe in
Morning.
42' 2"

(SNA:
Swelling?)

Summary Vol

30
30
30
35
30
30
35
35

Summary 290
+ 40 gal H₂O 320
4.5 gal. Cement
1/2" Bentonite

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: <u>MWS-01</u>	Installation: <u>SKY HARBOR BACKGROUNDS WELL</u>	Site: <u>BRIDGEWAY WAREHOUSE</u>
Project No.: <u>40424-01</u>	Client/Project: <u>HAZWRAP / SKY HARBOR BGS AN6</u>	
HAZWRAP Contractor: <u>TCI SERVICES</u>	Drig Contractor: <u>JOHN R. ANDERSON MECHANICAL</u>	
Comp. Start: <u>1/20/91</u>	(09:00 A.M.)	Comp. End: <u>1/30/91</u>
Built By: <u>GARDINER</u>		Well Coord.: <u>N 9484.29</u> <u>E 11768.37</u>

Elev. 1118.70Height 0GS Elev. 1118.70GS Height 0.00'

Depth BGS

Elev. 1118.40Depth BGS 0.3Gravel Screen

40
20
20
20
20
20

140pl

Base course. 20

Base course. 2

Base course. 1

44.5
46.5
50.0

54.5

55.0

100'

101'

NA

TD: 101'

9 3/4"

Borehole dia.

PROTECTIVE CSG

Material / Type STEEL TUB W/ SLOTTED HOLE

Diameter

Depth BGS

Watertight O-Ring (Y/N)

SURFACE PAD

Composition & Size CONCRETE / 36" x 36" x 12"

Breathes With Vadose Zone (Y/N)

RISER PIPE

Type STEEL TUB W/ SLOTTED HOLE

Diameter

Total Length (TOC to TOS)

Ventilated Cap (Y/N)

GROUT

Composition & Proportions 7 Parts Type I Portland Cement+ 1 Part Bentonite Grout + 35-40pl H₂O

Tremied (Y/N)

Interval BGS

CENTRALIZERS (Y/N)

Depth(s)

SEAL

Type 1/4" thick Urethane Bitumastic Sealant

Source

Setup/Hydration time 15 min.Vol. Fluid Added 10pl H₂OTremied (Y/N) 20

FILTER PACK

Type 20/40 Gravel Screen Sand / 60 Silicon SandAmt. Used 19 1/2 bags, 1/2 bag

Tremied (Y/N)

Source

Gr. Size Dist. 20/40 Gravel Screen Sand + 60 Silicon Sand

SCREEN

Type STEEL TUB W/ SLOTTED HOLE

Diameter

Slot Size & Type 1/2" x 1/2"

Interval BGS

SLUMP (Y/N)

Interval BGS

Bottom Cap (Y/N)

BACKFILL PLUG

Material NASetup/Hydration time NA

Tremied (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: <u>MUS-02</u>	Installation: <u>SKY HARBOR</u>	Site: <u>BALCONIA WALK</u>
Project No.: <u>40721.02</u>	Client/Project: <u>HAZWRAP/SKY HARBOR AVE.</u>	
HAZWRAP Contractor: <u>TP Construction</u>	Drig Contractor: <u>LATITE ENVIRONMENTAL</u>	
Comp. Start: <u>2/6/91</u> (<u>08:05</u> A.m)	Comp. End: <u>2/6/91</u> (<u>10:00</u> A.m)	
Built By: <u>GARDNER</u>	Well Coord.: <u>N 8941.36</u> <u>E 10847.55</u>	

Elev. 1115.91Height 0GS Elev. 1115.91GS Height 0.00'

Depth BGS

Elev. 1115.61Depth BGS 0.3

Gallons Sugar

35
30
30
45
140 gal

42.5
45.5
50'

2.4

55.5'

54.0'

100'

101'

NA

TD. 101.6

Borehole dia. 9 3/4"

PROTECTIVE CSG

Material / Type STEEL TOP / SWEET METAL BOTTOM

Diameter

Depth BGS

Watertight O-Ring (Y/N) ST 1-4-1

SURFACE PAD

Composition & Size 3 ft. x 3 ft. x 1 ft. ConcreteBreathes With Vadose Zone (Y/N)

RISER PIPE

Type SCH. 40 PVCDiameter 4 inch I.D.Total Length (TOC to TOS) 506Ventilated Cap (Y/N)

GROUT

Composition & Proportions 4 bags Tris II CementTD 1/2 bag Bentonite + ~ 25-40 gal H₂OTremied (Y/N) 15 ft Cement, 1 ft Bentonite

Interval BGS

CENTRALIZERS (Y/N)Depth(s) NA

SEAL

Type 1/4" Wiremesh Bentonite Pellets 1 BKT

Source

Setup/Hydration time 20 min Vol. Fluid Added 10 galTremied (Y/N)

FILTER PACK

Type 20/40 Crushed Screen Sand + 60 GrainsAmt. Used 10 5x 20/40; 1/2 5x 60Tremied (Y/N)

Source

Gr. Size Dist. 20/40 Filter Pack; 60 D₅₀ TOP

SCREEN

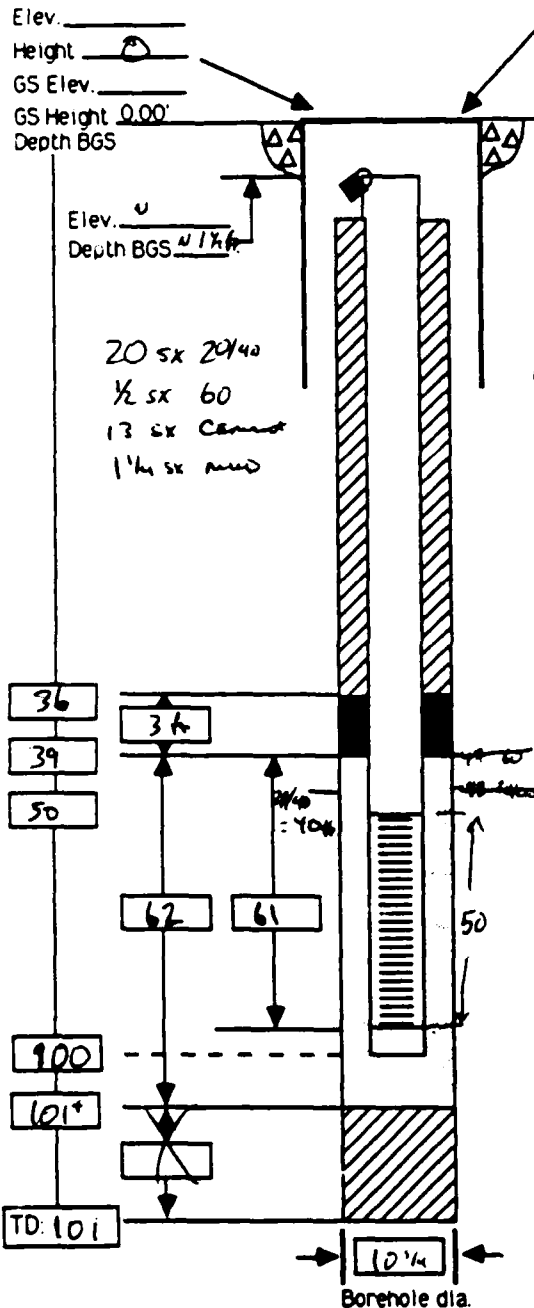
Type SCH. 40 PVCDiameter 4 inch I.D.Slot Size & Type 0.010 mmInterval BGS 450-100 ft.SUMP (Y/N)Interval BGS NA Length 2 ftBottom Cap (Y/N)

BACKFILL PLUG

Material NASetup/Hydration time NATremied (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: MWS-04	Installation: Sky Harbor Air Base	Site: Back Camp Well
Project No.: 40721	Client/Project: HAZWRAP/Sky Harbor Air	
HAZWRAP Contractor: IT Corporation	Drill Contractor: LARRY ENVIRONMENTAL	
Comp. Start: 3/21/91 (2:25 P.M.)	Comp. End: 3/21/91 (4:30 P.M.)	
Built By: GARDINER	Well Coord.: _____	



PROTECTIVE CSG

Material / Type Steel Top, Aluminum Bottom
 Diameter 12"
 Depth BGS From top - 1 ft.
 Watertight O-Ring (Y) N

SURFACE PAD

Composition & Size 20" fluid cap over ASP
 Breaches With Vadose Zone (Y/N)

RISER PIPE

Type Schedule 40 PVC
 Diameter 4 in. I.D.
 Total Length (TOC to TOS) 50'
 Ventilated Cap (Y/N)

GROUT

Composition & Proportions 5% Bentonite / Type II
Portland Cement Grout
 Tremied (Y/N)
 Interval BGS 0-36 ft.

CENTRALIZERS (Y/N)

Depth(s) _____

SEAL

Type 1/4" Wrenn Bentonite Putty
 Source Enviro Pure
 Setup/Hydration time 10 min. Vol. Fluid Added 1 qt.
 Tremied (Y/N)

FILTER PACK

Type 20/40 coarse silver sand / 60 mesh
 Amt. Used _____
 Tremied (Y/N)
 Source _____
 Gr. Size Dist. 20/40 Pass, 60 on top

SCREEN

Type Schedule 40 PVC
 Diameter 4 in. I.D.
 Slot Size & Type 0.010 in
 Interval BGS 50-100

SLUMP (Y/N)

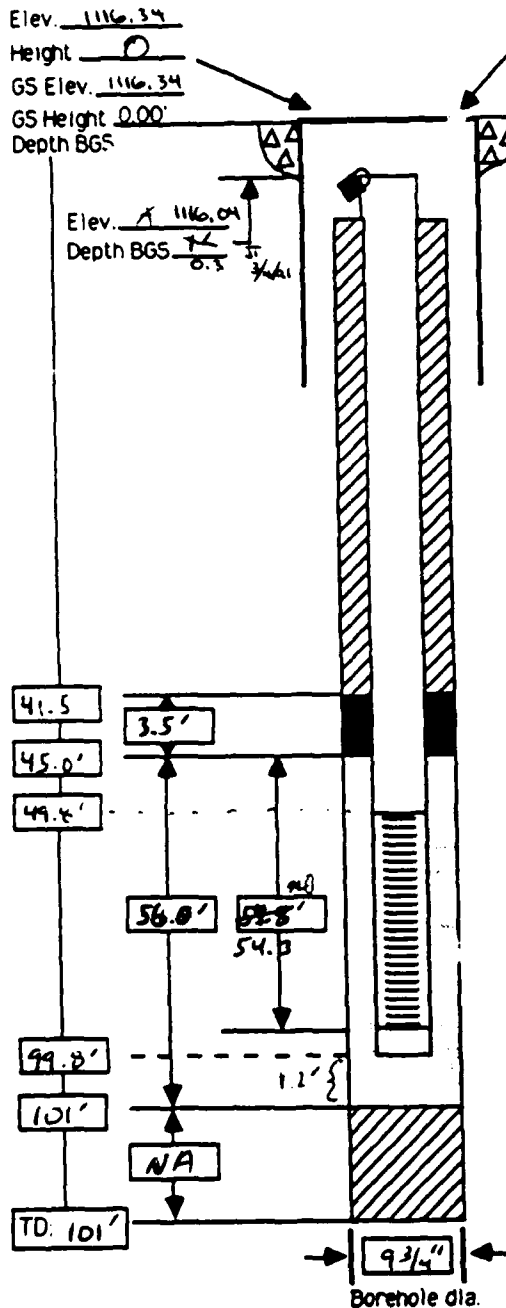
Interval BGS 100-101 ft. Length 1 ft.
 Bottom Cap (Y/N)

BACKFILL PLUG

Material NA
 Setup/Hydration time NA
 Tremied (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: MW1-02	Installation: Sky Harbor	Site: 1
Project No.: 0181	Client/Project: HAZWRAP / Sky Harbor Air	
HAZWRAP Contractor: IT Corporation	Drig Contractor: LYNNE ENVIRONMENTAL	
Comp. Start: 1/29/91 (12:45 P.M.)	Comp. End: 1/29/91 (15:00 P.M.)	
Built By: GARDNER	Well Coord: N 992.28 E 10606.30	

**PROTECTIVE CSG**

Material / Type: STEEL TOP, SHEET PILE SIZES
 Diameter: _____
 Depth BGS: _____
 Watertight O-Ring (Y/N): (Y/N)

SURFACE PAD

Composition & Size: CONCRETE / 3' x 3' x 3'
 Breaches With Vadose Zone (Y/N): (Y/N)

RISER PIPE

Type: SCHEDULE 40 PVC
 Diameter: 4 inch I.D.
 Total Length (TOC to TOS): 49 ft.
 Ventilated Cap (Y/N): (Y/N)

GROUT

Composition & Proportions: ANKER 4 PART TYPE T&T
Concrete + 1/2 Bag Bentonite Paste to 95-4000 H₂O
 Tremied (Y/N): (Y/N)
 Interval BGS: _____

CENTRALIZERS (Y/N)

Depth(s): _____

SEAL

Type: 1/4" WYOMING BENTONITE PELLETS
 Source: _____
 Setup/Hydration time: 15 mins Vol Fluid Added 100%
 Tremied (Y/N): (Y/N)

FILTER PACK

Type: 20/40 CONCRETE SIMILAR SAND
 Amt. Used: 19 1/2 BAGS 20/40 + 1/2 BAG 60
 Tremied (Y/N): (Y/N)
 Source: _____
 Gr. Size Dist.: 20/40 FOR SAND PACK, 60 FOR TD/1/2 PAK
(44%)

SCREEN

Type: SCHEDULE 40 PVC
 Diameter: 4 inch I.D.
 Slot Size & Type: 0.010
 Interval BGS: 50 ft. of SCREEN

SUMP (Y/N)

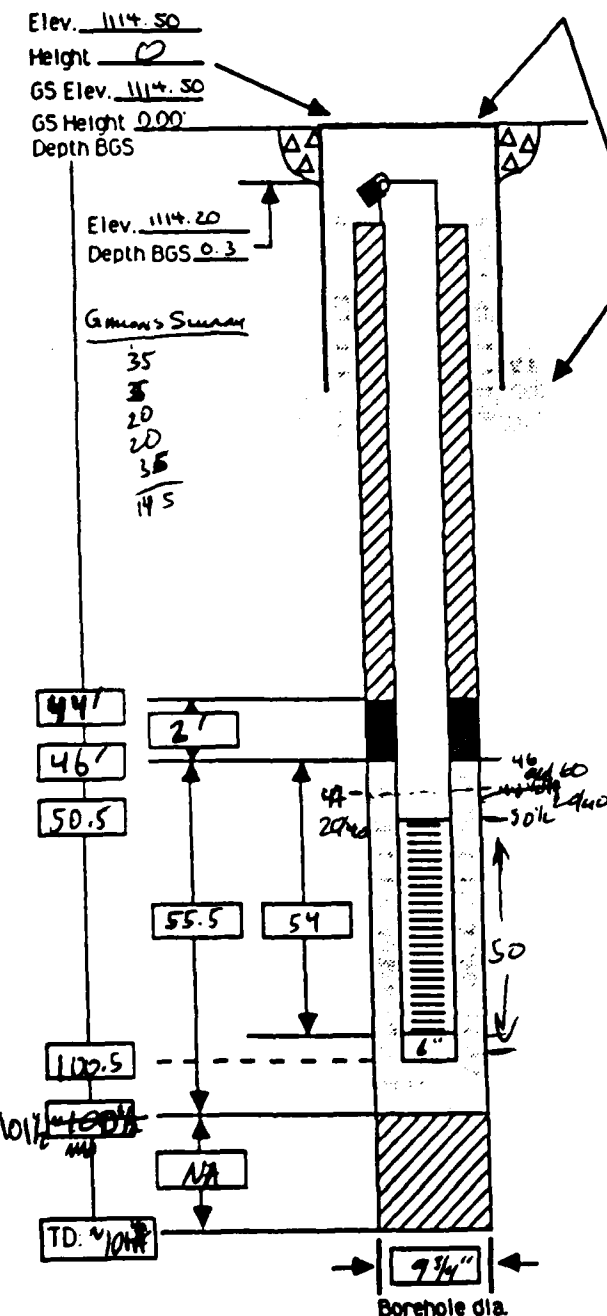
Interval BSG: _____ Length: _____
 Bottom Cap (Y/N): (Y/N)

BACKFILL PLUG

Material: NA
 Setup/Hydration time: NA
 Tremied (Y/N): (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL ID: MW2-02	Installation: Sky Harbor	Site: 2
Project No: 10112-02	Client/Project: HAZWRAP / Sky Harbor A116	
HAZWRAP Contractor: IT Corporation	Drig Contractor: LARSEN Environmental	
Comp. Start: 2/6/91 (14:50 P.m)	Comp. End: 2/6/91 (16:20 P.m)	
Built By: GARDNER	Well Coord.: N 9801.70 E 10386.43	



PROTECTIVE CSG
Material / Type STEEL TUB / SWEET MEAT BOTTOM
Diameter _____
Depth BGS _____
Watertight O-Ring (Y) (N) 3-4-91

SURFACE PAD
Composition & Size 3 ft. x 3 ft. x 1 ft. Concrete
Breathes With Vadose Zone (Y / N)

RISER PIPE
Type 4 in. PVC
Diameter 4 in. I.D.
Total Length (TOC to TOS) 50 ft.
Ventilated Cap (Y / N)

GROUT
Composition & Proportions 4 Bags Type I & II Cement, 1/2 Bag Bentonite Powder + 2.75-4.0 gal H₂O
Tremied (Y / N)
Interval BGS _____

CENTRALIZERS (Y / N)
Depth(s) _____

SEAL
Type 1/4" Dimpled Rubber
Source _____
Setup/Hydration time _____ Vol. Fluid Added 12 gal 420
Tremied (Y / N)

FILTER PACK
Type 20/40 Coarse Sand + 60 Mesh
Amt. Used 19 Bags 20/40, 1/2 Bag 60
Tremied (Y / N)
Source _____
Gr. Size Dist. 20/40 Filter Pack + 1/2 Bag 60 on top

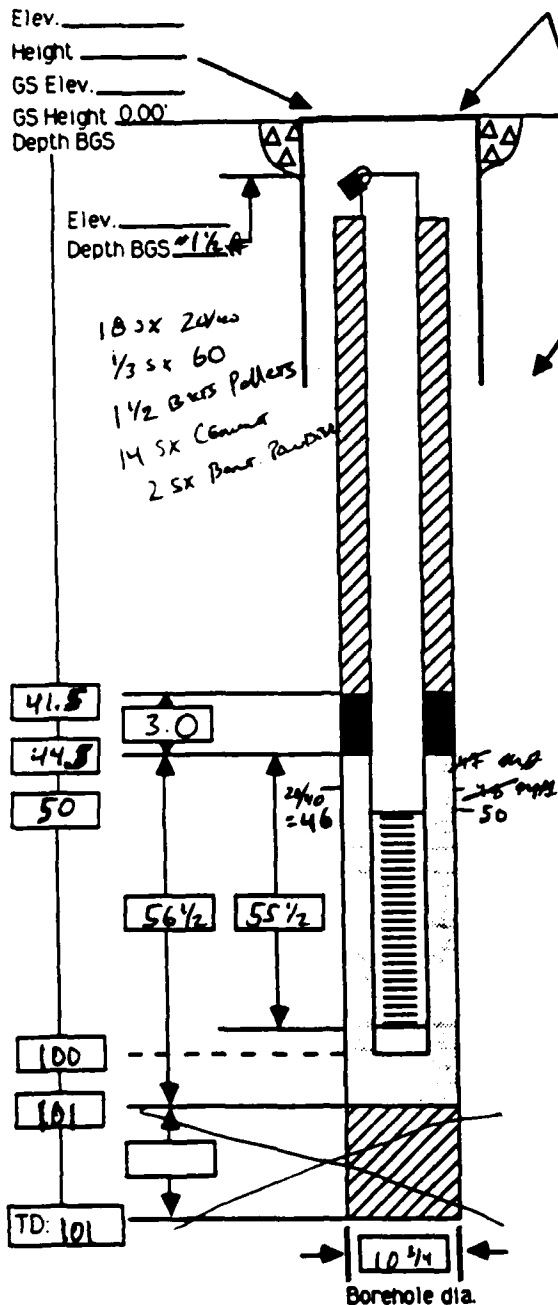
SCREEN
Type 4 in. PVC
Diameter 4 in. I.D.
Slot Size & Type 0.010 in., 50 ft.
Interval BGS _____

SUMP (Y / N)
Interval BGS 100 1/2 to 101 1/2 Length 1 ft
Bottom Cap (Y / N)

BACKFILL PLUG
Material NA
Setup/Hydration time NA
Tremied (Y / N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount		
WELL NO.: MW3-01	Installation: Sky Harbor ANG Base	Site: 3
Project No.: 40121	Client/Project: HAZWRAP / Sky Harbor ANG	
HAZWRAP Contractor: IT Corporation	Drig Contractor: Layne Environmental	
Comp. Start: 3/22/91 (12:45 PM)	Comp. End: 3/22/91 (15:10 PM)	
Built By: GARDNER	Well Coord.: _____	

**PROTECTIVE CSG**

Material / Type Steel Top, Aluminum Bottom
 Diameter 12"
 Depth BGS 0-1 1/2 ft
 Watertight O-Ring (Y/N)

SURFACE PAD

Composition & Size Concrete under Asphalt
 Breathes With Vadose Zone (Y/N)

RISER PIPE

Type Schedule 40 PVC
 Diameter 4 inches ID
 Total Length (TOC to TOS) 50 ft.
 Ventilated Cap (Y/N)

GROUT

Composition & Proportions 5% Bentonite / Tremie
Polyurethane Grout
 Tremied (Y/N)
 Interval BGS 0-41 1/2 ft

CENTRALIZERS (Y/N)

Depth(s) _____

SEAL

Type 1/2" Wyrising Bandaid Rollers
 Source Polyurethane
 Setup/Hydration time 20 Days Vol. Fluid Added 100%
 Tremied (Y/N) Hzd

FILTER PACK

Type 20/40 Colson Silica Sand, 60 Mesh
 Amt. Used 18 SX
 Tremied (Y/N)
 Source Colson Silica Sand
 Gr. Size Dist. 20/40 Mesh, 60 on top

SCREEN

Type Schedule 40 PVC
 Diameter 4 inches ID
 Slot Size & Type 0.010
 Interval BGS 50-100 ft.

SUMP (Y/N)

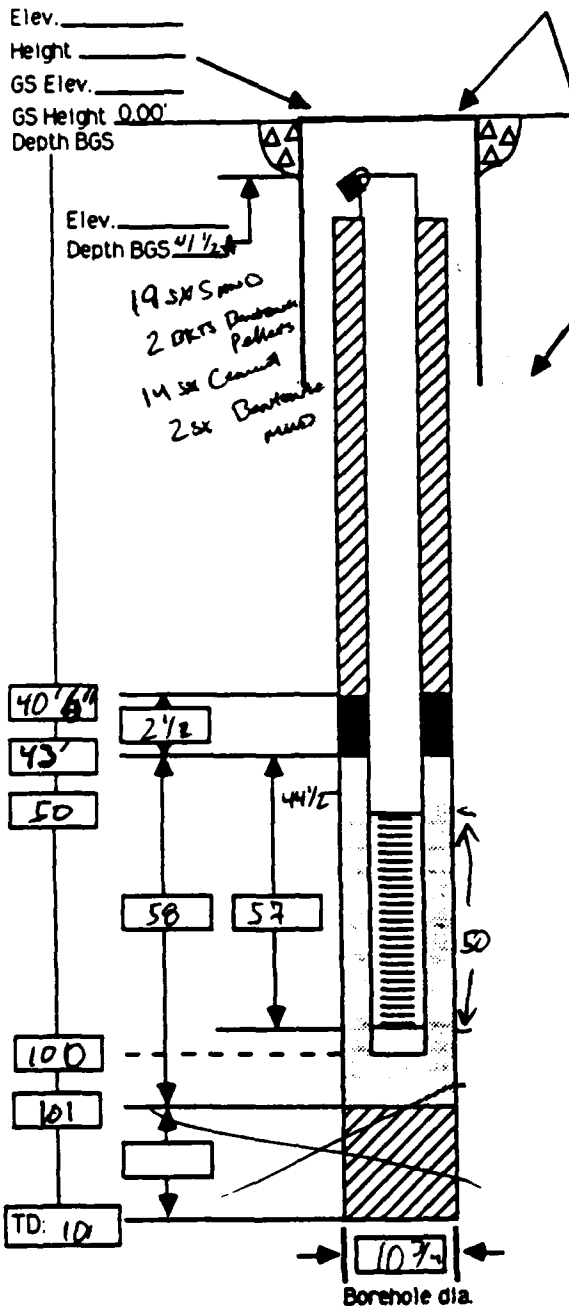
Interval BGS 100-100 Length 1
 Bottom Cap (Y/N)

BACKFILL PLUG

Material NA
 Setup/Hydration time NA
 Tremied (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: MW3-02	Installation: Sky Hazard Area Base	Site: 3
Project No.: 40831	Client/Project: HAZWRAP / Sky Hazard Area	
HAZWRAP Contractor: IT Corporation	Drig Contractor: LAYNE Environmental Services	
Comp. Start: 3/23/91 (1:45 PM)	Comp. End: 3/23/91 (4:30 PM)	
Built By: GARDIN	Well Coord.: _____	

**PROTECTIVE CSG**

Material / Type Steel Top / Aluminum Bottom
Diameter 12"
Depth BGS 0-1 1/2'
Watertight O-Ring (Y)(N)

SURFACE PAD

Composition & Size 3x3x1 Concrete
Breathes With Vadose Zone (Y/N)

RISER PIPE

Type Schedule 40 PVC
Diameter 4 inch I.D.
Total Length (TOC to TOS) 0' 0 1/2'
Ventilated Cap (Y)(N)

GROUT

Composition & Proportions 5% Bentonite / Type I & II Portland Cement Grout
Tremied (Y)(N)
Interval BGS 0-40 1/2'

CENTRALIZERS (Y)(N)

Depth(s) _____

SEAL

Type 1/2 inch WRapping Bentonite Palliers
Source Enviroline
Setup/Hydration time 15 min Vol. Fluid Added 1 gal
Tremied (Y)(N) - 0

FILTER PACK

Type 20/40 Colloidal Silica Sand, 60 Colloidal Silica
Amt. Used 19 SK
Tremied (Y)(N)
Source Colloidal Silica
Gr. Size Dist. 20/40 Pass, 60 on ret

SCREEN

Type Schedule 40 PVC
Diameter 4 inch I.D.
Slot Size & Type 0.010 inch
Interval BGS 50-100'

SUMP (Y)(N)

Interval BGS 100-101' Length 1'
Bottom Cap (Y)(N)

BACKFILL PLUG

Material NA
Setup/Hydration time NA
Tremied (Y)(N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: <u>MW-5-01</u>	Installation: <u>Sky Haz-Box</u>	Site: <u>5</u>
Project No.: <u>40342.02</u>	Client/Project: <u>HAZWRAP / Sky Haz-Box ANV</u>	
HAZWRAP Contractor: <u>IT Construction</u>	Drig Contractor:	
Comp. Start: <u>2/24/1</u> (<u>12:00</u> <u>P</u> m)	Comp. End: <u>2/24/1</u> (<u>14:00</u> <u>P</u> m)	
Built By: <u>Gardner</u>	Well Coord.: <u>N 9345.98</u> <u>E 11050.01</u>	

Elev. 1117.10Height 0GS Elev. 1117.10GS Height 0.00

Depth BGS

Elev. 1116.80Depth BGS 0.3

Summit

35

30

35

15

25

15

15

140 gallons

42
44
50

57

56

100

101

NA

TD: N/DIA

Borehole dia.

PROTECTIVE CSG

Material / Type Steel Top / Smoothed Bottom

Diameter

Depth BGS

Watertight O-Ring (Y/N) IT 3-4-41

SURFACE PAD

Composition & Size 3' x 3' x 1' Concrete

Breathes With Vadose Zone (Y/N)

RISER PIPE

Type 4" 40 ALDiameter 4" I.D.Total Length (TOC to TOS) 50ft

Ventilated Cap (Y/N)

GROUT

Composition & Proportions 4" 40 AL cement + 1/2" 5x 35-40 mesh H&D; 15 Gallons

Tremied (Y/N)

Interval BGS 0-42 ft

CENTRALIZERS (Y/N)

Depth(s) NA

SEAL

Type 1/2" Wyring Bandwidth Pallet

Source

Setup/Hydration time 15 min Vol. Fluid Added 100

Tremied (Y/N)

FILTER PACK

Type Colorado Screen Sand & GravelAmt. Used 28 5x 20/40 1/2 5x 60

Tremied (Y/N)

Source

Gr. Size Dist. 20/40 Fine Gravel + 60 mesh

SCREEN

Type 4" 40 PVCDiameter 4" I.D.Slot Size & Type 0.010 meshInterval BGS (0-42) + 100 ft = 50 ft

SUMP (Y/N)

Interval BGS 101 to 100 Length 1 ft

Bottom Cap (Y/N)

BACKFILL PLUG

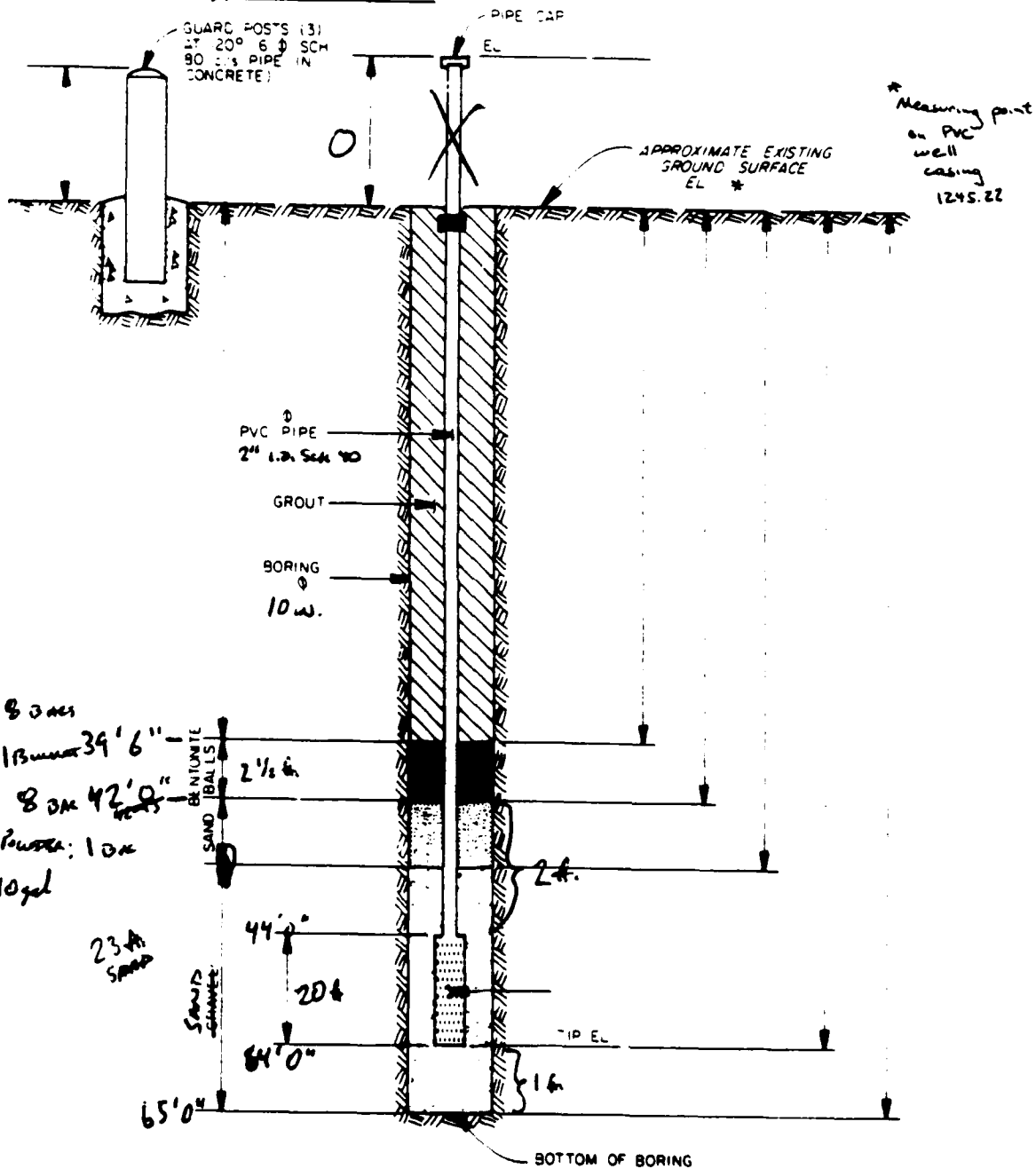
Material NASetup/Hydration time NA

Tremied (Y/N)



PIEZOMETER INSTALLATION SKETCH

PROJECT NAME SKY HANCOCK AVE INSTALLED BY GREENBERG DATE 1/20/61
PROJECT NO 40921.02.06 CHECKED BY NA DATE NA
BORING NO
PIEZOMETER NO PP-01



MATERIALS

SAND: 8 bags

PELLETS: 13 bags 39' 6" -

CEMENT: 8 bags 42' 0" -

BENTONITE PASTE: 1 bag

WATER: 10 gal

Slurry

35

35

15

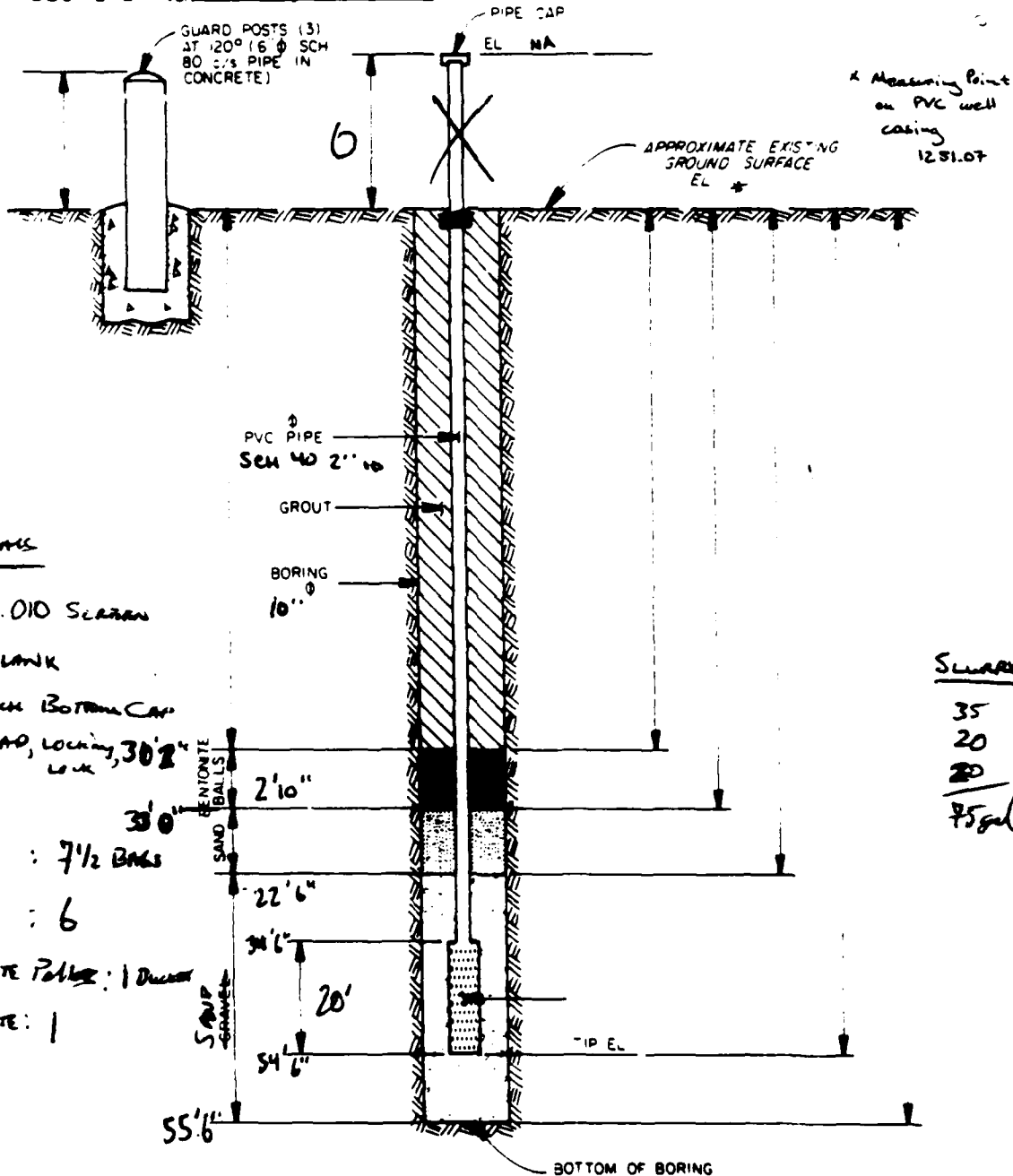
85 gal



PIEZOMETER INSTALLATION SKETCH

PROJECT NAME SHARK
PROJECT NO 401721.02.06
BORING NO PP-02
PIEZOMETER NO PP-02

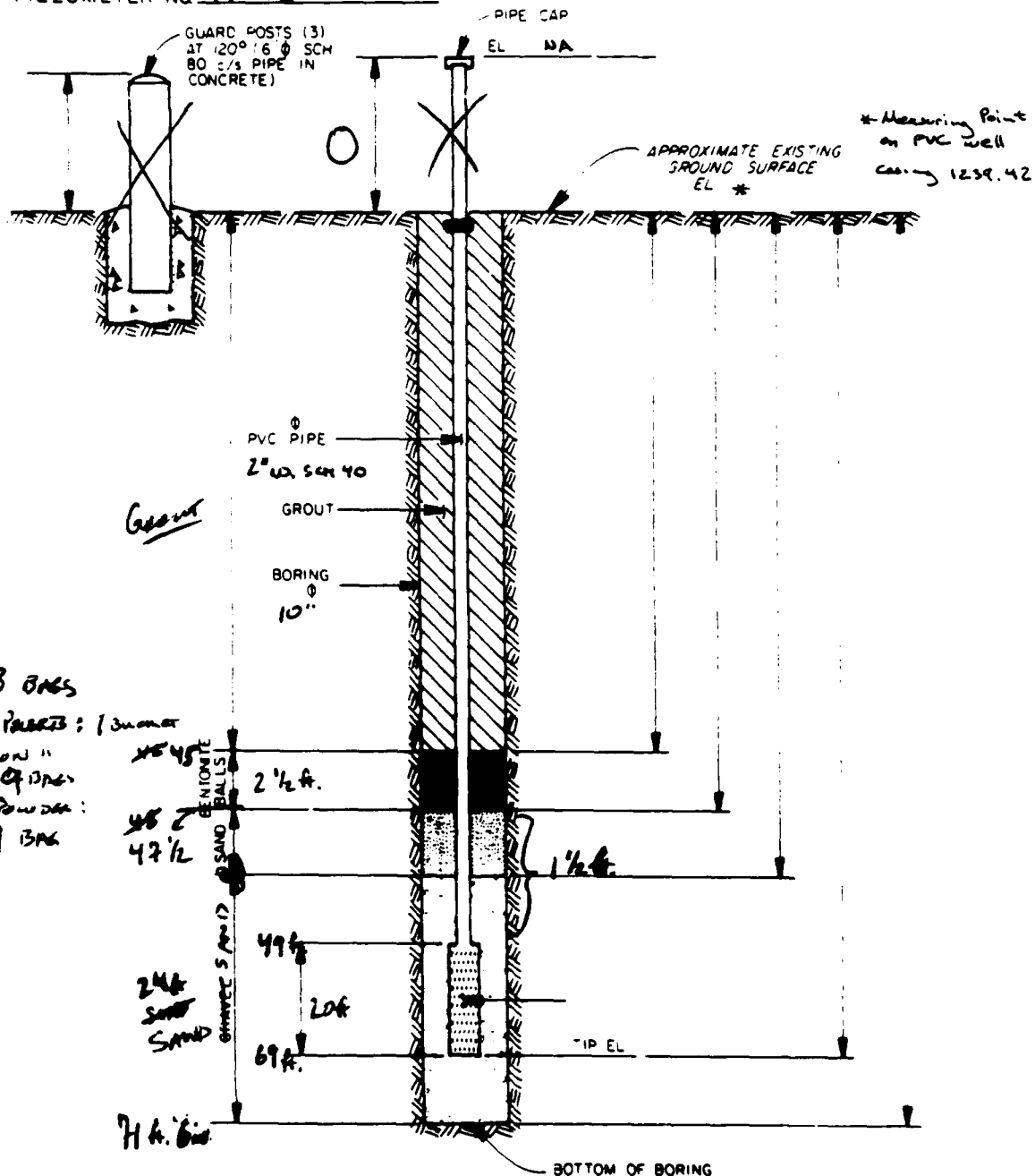
INSTALLED BY Guadalupe DATE 1/19/91
CHECKED BY NA DATE NA





PIEZOMETER INSTALLATION SKETCH

PROJECT NAME Sky Harbor ANG INSTALLED BY GARDNER DATE 1/20/91
PROJECT NO 409221-02.06 CHECKED BY NA DATE NA
BORING NO NA
PIEZOMETER NO PP-03



REV. DATE: MAY 1990

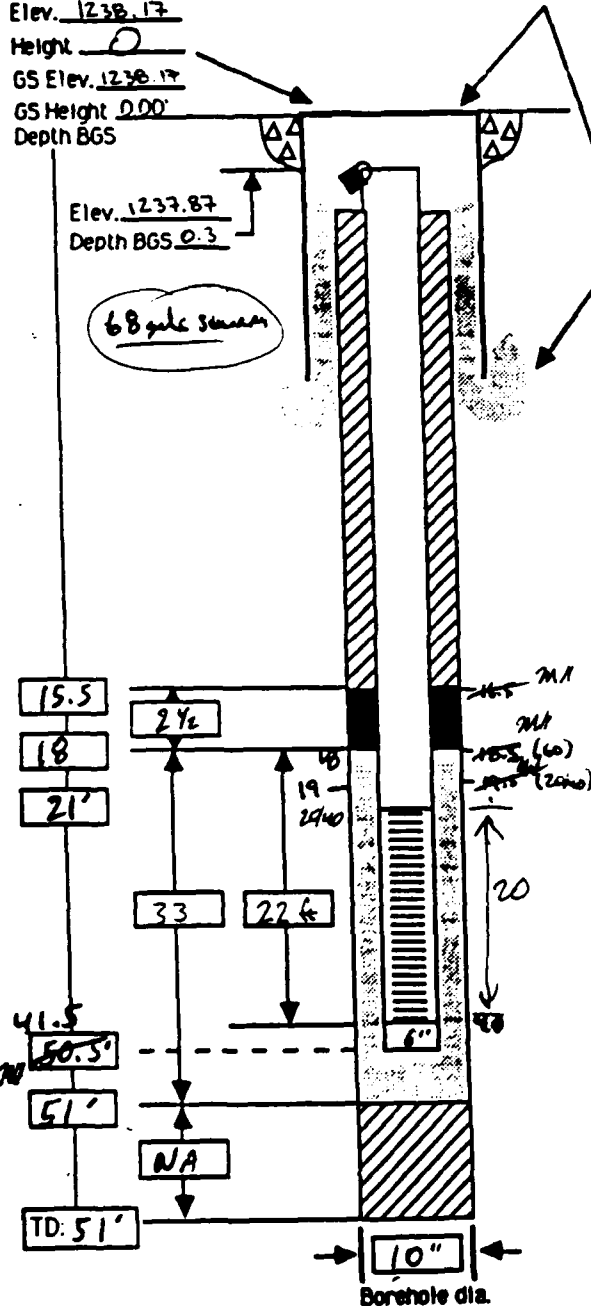
MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: MW4-01	Installation: <u>PARIA MOUNTAIN RESERVATION</u>	Site: <u>4</u>
Project No.: <u>40134</u>	Client/Project: <u>HAZWRAP / SKY HAWK ANK</u>	
HAZWRAP Contractor: <u>IT CORPORATION</u>	Drig Contractor: <u>LAYNE ENGINEERING</u>	
Comp. Start: <u>2/1/91</u> (<u>15:20</u> P.m)	Comp. End: <u>2/8/91</u> (<u>12:40</u> P.m)	
Built By: <u>GARDNER</u>	Well Coord.: <u>N 13733.39</u> <u>E 5749.74</u>	

Elev. 1238.17Height 0GS Elev. 1238.17GS Height 0.00'

Depth BGS

Elev. 1237.87Depth BGS 0.3

68 gals sensor



PROTECTIVE CSG

Material / Type STEEL PIPE / SHEET METAL BOTTOMDiameter 4 in. I.D.Depth BGS 0.3Watertight O-Ring (Y/N) 3-4-91

SURFACE PAD

Composition & Size 3 ft. x 3 ft. x 1 ft. CONCRETEBreathes With Vadose Zone (Y/N)

RISER PIPE

Type Sen. 40 PVCDiameter 4 in. I.D.Total Length (TOC to TOS) 22 ft.Ventilated Cap (Y/N)

GROUT

Composition & Proportions 40% TYPE I & II CEMENT, 60% BASE SANDTremied (Y/N)Interval BGS 0-15.5 75% Cement 25% SandCENTRALIZERS (Y/N)Depth(s) 3.2 ft. ; 4 ft.

SEAL

Type 1/4" Wyoming Bentonite PlugSource N/ASetup/Hydration time 1/2 hr. Vol. Fluid Added 10 gal. H₂OTremied (Y/N)

FILTER PACK

Type Colorado Silver SandAmt. Used 19.5 x 20/40 ; 1/2 x 40Tremied (Y/N)Source N/AGr. Size Dist. 20/40 Filter Sand ; 60 on 100

SCREEN

Type Sen. 40 PVCDiameter 4 in. I.D.Slot Size & Type 0.010 in.Interval BGS 21-41.5

SUMP

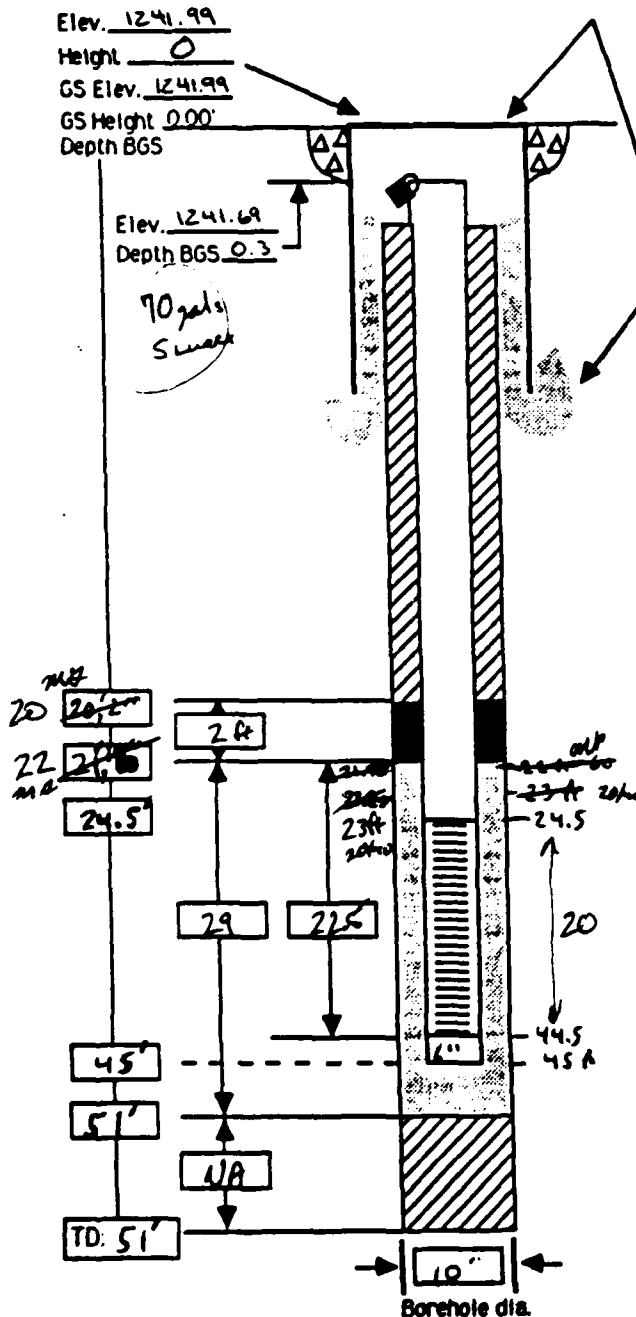
Interval BGS 41.5-51 Length 9.5 ft.Bottom Cap (Y/N)

BACKFILL PLUG

Material N/ASetup/Hydration time N/ATremied (Y/N)

REV. DATE: MAY 1990

MONITORING WELL CONSTRUCTION LOG -- Standard Flush Mount		
WELL NO.: MW4-02	Installation: <u>Papilio Mound Reservoir</u>	Site: <u>4</u>
Project No.: <u>40131.04</u>	Client/Project: <u>HAZWAP / Sky Harbor Ave</u>	
HAZWAP Contractor: <u>IT Corporation</u>	Drig Contractor: <u>Larive Environmental</u>	
Comp. Start: <u>2/1/91</u> (<u>12:30</u> <u>PM</u> <u>EST</u>)	Comp. End: <u>2/8/91</u> (<u>12:15</u> <u>PM</u> <u>EST</u>)	
Built By: <u>GARDINER</u>	Well Coord: <u>N 1332.21</u> <u>E 5959.36</u>	



PROTECTIVE CSG

Material / Type Steel Pipe / Stainless Steel Bottom
 Diameter _____
 Depth BGS _____
 Watertight O-Ring 1/4" 3-4-91

SURFACE PAD

Composition & Size 3 ft x 3 ft x 1 ft Concrete
 Breathes With Vadose Zone (Y/N)

RISER PIPE

Type Sch. 40 PVC
 Diameter 4 in. I.D.
 Total Length (TOC to TOS) 24.5 ft
 Ventilated Cap (Y/N)

GROUT

Composition & Proportions 4 Bags Type III Cement + 1/2 Bag Bentonite + 35-40 Gal Water

Tremied (Y/N) (Y)
 Interval BGS 0-20 ft (1/2 Bag Bentonite + 1/2 Bag Cement)

CENTRALIZERS (Y/N)

Depth(s) 24.5 ft; 50 ft

SEAL

Type 1/4" bonding Bitumenite Permeate
 Source _____
 Setup/Hydration time 1 hr Vol. Fluid Added 10 gal Water
 Tremied (Y/N) (Y)

FILTER PACK

Type Coarse Sand / Gravel
 Amt. Used 8.5 x 20/40; 1/2 x 60
 Tremied (Y/N) (Y)
 Source _____
 Gr. Size Dist. 20/40 Filter Pack; 60 on top

SCREEN

Type Sch. 40 PVC
 Diameter 4 in. I.D.
 Slot Size & Type 0.010 in.
 Interval BGS 44.5-45.5 (20 ft)

SUMP (Y/N)

Interval BGS 45-51 Length 6 ft
 Bottom Cap (Y/N) (Y)

BACKFILL PLUG

Material NA
 Setup/Hydration time NA
 Tremied (Y/N) (Y)

APPENDIX G

**PIEZOMETER AND MONITORING WELL
DEVELOPMENT RECORDS**

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG PS-1		Well No.: PS-1	Page 1 of 1
Installation:		Site: General	
Project No.: 409721	Client/Project: MMEIS / Sky Harbor ANG		
HAZWRAP Contractor:	Dev. Contractor: Casper Environmental		
Dev. Start (: m)	Dev. End: (: m)	Csg Dia.: 2 inch	
Developed by: NA		Dev. Rig (Y/N)	

Dev. Method Surge with bailer and extract 10-20 well volumes
with Bailer

Equipment Smeal T-5

Pre-Dev. SWL _____ Maximum drawdown during pumping _____ ft at ~ 0.5 gpm

Range and Average Discharge rate 0.5 over gpm

Total quantity of material bailed _____

Total quantity of water discharged by pumping NA

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp ° C	pH	Conductivity	Remarks
			NA					Well could not be developed with 9 ft bailer on hand. Blocked at 55 ft. Will attempt with shorter bailer at later date. IRT 4/22/91



INTERNATIONAL
TECHNOLOGY
CORPORATION

By JRT Date 1-20-91 Subject Calc. Well PS-1 Sheet No. 1 of 1
Chkd. By ■ Date ■ Casing Volume Proj. No. 409721

Total Depth : 98.42 ft
Water Depth : 76.12 ft
Water Column : 22.30 ft

$$\text{Vol} = \left(2.0 \times \frac{1 \text{ ft}}{12.0} \right)^2 \div 4 \times \pi \times 22.30 = 0.48 \text{ ft}^3$$

or
3.6 gals

\therefore Bail 36 to 72 gals

FIGURE 5-4c

REV DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No. PS1	Page 1 of 1
Installation Sky Harbor	Coordinates	Site 1	
Project No. 40972102.06		Client/Project Sky Harbor ANA Base	
HAZWRAP Contractor IT Corp	Dev Contractor		
Dev Start (15.4 m)	Dev End (17.00 m)	Csg Dia. 4" ID	
Developed by Layne Environmental		Dev Rig (Y/N)	

Dev Method Bailer ; surging in waterEquipment 1.5"x10'PVC Bottom loading BailerPre-Dev. SWL 97.53ft Maximum drawdown during pumping NA 't at NA ftRange and Average Discharge rate N/ATotal quantity of material bailed 27 gallonsTotal quantity of water discharged by pumping N/ADisposition of discharge water Held in poly tanks for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1546			Muddy	Muddy	24.8	7.27	1000 μ S	
1557	5		Muddy	Muddy	23.5	6.96	980 μ S	
1606	10		Muddy	Muddy	23.0	7.07	970 μ S	
1620	13				22.2	7.09	960 μ S	
1630	15				23.0	7.02	970 μ S	
1640	18				23.1	7.02	950 μ S	
1655	248				22.3	6.93	950 μ S	
1700	278				22.5	6.96	970 μ S	
					22.4	6.8	940 μ S	
					6.93			

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG <u>P5-2</u>		Well No.: <u>P5-2</u>	Page <u>1</u> of <u>1</u>
Installation:		Site: <u>General</u>	
Project No.: <u>409721</u>	Client/Project: <u>MMEs / Sky Harbor ANG</u>		
HAZWRAP Contractor:	Dev. Contractor: <u>Layne Environmental</u>		
Dev. Start (12:10 <u>m</u>)	Dev. End: (13:52 <u>m</u>)	Csg Dia.: <u>2 inch</u>	
Developed by: <u>Layne Env Southwest Well Services</u>		Dev. Rig (Y/N)	

5' x 4"

Developed 1-20-91

Dev. Method Surge with bailer and extract 10-20 well volumes with bailer

Equipment Smel T-5

Pre-Dev. SWL 74.95 Maximum drawdown during pumping ~74.95 ft at ~0.5 gpm

Range and Average Discharge rate .05 over 1 hr 43 min gpm

Total quantity of material bailed 45 gals

Total quantity of water discharged by pumping NA

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1210	10		NA	cloudy	20.5	7.15	1170	Fine Sand silt
1229	15			Brown cloudy	20.3	7.49	1080	Fine sand silt
1243	16			cloudy/brown	21.0	7.40	1110	Silty (up fine) settles
1248	20			cloudy/brown	21.0	7.42	1120	silty / settling quickly
1309	23			cloudy/brown	20.8	7.34	1130	silty / settling to clear
1329	26			cloudy/brown	20.3	7.34	1150	silty / settling to clear
1333	27			cloudy/brown	20.2	7.22	1110	silty / and settling
1345	30			cloudy	20.4	7.43	1190	silty and settling
1348	31			cloudy	20.9	7.30	1110	silty
1353	32			cloudy	21.1	7.37	1080	silty (bottle sample for P120)



By JRT Date 1-20-41 Subject Calc Well PS-2 Sheet No. 1 of 1
Chkd. By Date Casing Volume Proj. No. 409721

Total Depth : 99.86
Water Depth : 81.82
Water Column : 18.04

$$Vol = \left(2.12 \times \frac{1 \text{ ft}}{12 \text{ in}} \right)^2 \div 4 \times \pi \times 18.04 = 0.39 \text{ ft}^3$$

or
~ 3 gals

∴ Bail 30 to 60 gals

WELL DEVELOPMENT LOG		Well No. <u>SHP-2</u>	Page <u>1</u> of <u>1</u>
Installation: <u>Sky Harbor</u>	Coordinates	Site: <u>NA</u>	
Project No.: <u>409721.02.06</u>	Client/Project <u>Sky Harbor ANG</u>		
HAZWRAP Contractor: <u>IT Corp</u>	Dev. Contractor:		
Dev Start <u>(13:35 m)</u>	Dev. End. <u>(14:38 m)</u>	Csg Dia. <u>2" ID</u>	
Developed by: <u>Layne Environmental</u>		Dev Rig <u>(Y/N)</u>	

2nd Development 2-4-91

Dev Method

Bailing

Equipment

1.5" Bottom loading PVC bailer

Pre-Dev. SWL

76.41

Maximum drawdown during pumping

NA

ft at

NA

Range and Average Discharge rate

NA

Total quantity of material bailed

~32 gal

Total quantity of water discharged by pumping

NA

Disposition of discharge water

Held in 55 gal drums for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1335	2		—	muddy	21.9	7.19	1130	Slight Color (petroleum) ↓
1353	10		—	muddy	21.8	7.22	1160	
1406	16		—	muddy	21.7	7.28	1080	
1417	21		—	muddy	21.8	7.15	1140	
1438	32		—	muddy	21.8	7.17	1170	

WELL DEVELOPMENT LOG PS-3		Well No.: PS-3	Page <u>1</u> of <u>1</u>
Installation:		Site: General	
Project No.: 409721	Client/Project: MAMES / Sky Harbor ANG		
HAZWRAP Contractor:	Dev. Contractor: Layne Env.		
Dev. Start (09:45 m)	Dev. End: (11:10 m)	Csg Dia.: 2 inch	
Developed by: Southwest Env. Well Services		Dev. Rig (Y/N)	

Developed 1-20-91

Dev. Method Surge with bailer and extract 10-20 well volumes
with bailer

Equipment ST Seal T-5

Pre-Dev. SWL 75.50 Maximum drawdown during pumping ~85 ft at ~0.5 gpm

Range and Average Discharge rate 0.5 gpm over 1 hr 20 mins gpm

Total quantity of material bailed 55 gals

Total quantity of water discharged by pumping NA

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity μ mhos	Remarks
0945			NA					
1008	15			Cloudy Brown	19.6	7.11	1080	Fine sand, silt
1026	18			Cloudy Brown	19.9	7.41	1060	Silty, sand
1032	24			Cloudy Brown	20.2	7.35	1050	Silty, fine sand
1046	30			Cloudy	20.4	7.28	1010	Silty
1050	35			Cloudy	20.5	7.31	1060	Silty
1055	42			Cloudy gray	20.8	7.40	1070	Silty
1100	50			Cloudy brown	21.3	7.31	1050	Silty, very fine
1108	55			Cloudy	20.5	7.32	1070	No visible fines
1110	55			Cloudy	20.9	7.36	1050	Clear enough for piezo



By JRT Date 1-20-91 Subject Calc. Well PS-3 Sheet No. 1 of 1
Chkd. By Date Casing Volume Proj. No. 409721

Total Depth : 98.42 ft
Water Depth : ~~76.12 ft~~ 83.48 ft
Water Column : ~~22.30 ft~~ 16.42 ft

$$Vol = \left(21 \times \frac{1 \text{ ft}}{12 \text{ in}} \right)^2 \div 4 \times \pi \times \frac{16.42}{22.30} = 0.36 \text{ ft}^3$$

or
~ 2 3/4 gals

∴ Bail 26 to 52 gals

WELL DEVELOPMENT LOG		Well No.: MW3-01	Page 1 of 1
Installation: Sky Harbor	Coordinates	Site: Background Well	
Project No.: 49721.02.00	Client/Project: Sky Harbor ANG		
HAZWRAP Contractor: IT Corp	Dev. Contractor:		
Dev Start (08:23__m)	Dev End: (01:28__m)	Csg Dia: 4" ID	
Developed by: Wayne Environmental		Dev. Rig (RYN)	
Developed 2-5-91			

Dev. Method Swab surge, bailer, submersible pump

Equipment 35/8" x 10' Bo Home loading steel bailer, 1.5 HP

Franklin: submersible pump

Pre-Dev. SWL 77.14 ft Maximum drawdown during pumping NA ft at NA gpm

Range and Average Discharge rate 5-20 gpm ^{10 gpm} nominal C

Total quantity of material bailed ~18 gals

Total quantity of water discharged by pumping 200-180 gals

Disposition of discharge water Held in poly tanks for analysis

[illegible]

WELL DEVELOPMENT LOG		Well No.: AWS-02	Page 1 of 1
Installation: Sky Harbor	Coordinates:	Site: Background	
Project No.: 409721	Client/Project: MMES / Sky Harbor ANG		
HAZWRAP Contractor: IT Corp	Dev. Contractor: Layne Env.		
Dev Start (11:15 AM)	Dev. End: (12:40 PM)	Csg Dia: 4 inch	
Developed by: Tyburki / Layne Env.		Dev. Rig (Y/N)	
Developed AWS-02			

Dev. Method Surge saturated screen interval; bail sediment as required; pump to visibly clean or 5 NTU's if possible

Equipment Small development rig

Pre-Dev. SWL 75.25 Maximum drawdown during pumping _____ ft at _____ S gpm

Range and Average Discharge rate 3-6 gpm avg approx 5 gpm

Total quantity of material bailed 20 gals

Total quantity of water discharged by pumping 180 gals

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
11:15	-	75.25	-	-	-	-	-	Start Surging
11:45	-							Start bailing
12:10	20			Brown	23.3	6.93	1130	Start pumping
12:15	35			Gr. Br.	23.7	7.23	1110	
12:23	60			Cloudy	23.3	7.40	1130	
12:32	140			Cloudy	23.5	7.26	1120	
12:35	170		41.1	Slightly Cloudy	23.4	7.40	1140	
12:40	200		21.5	Clear	23.6	7.23	1140	Stop. Clarity good

WELL DEVELOPMENT LOG		Well No. MW5-03	Page 1 of 1
Installation: Sky Harbor	Coordinates	Site: Background (cell)	
Project No.: 40972102.06	Client/Project: Sky Harbor ANG		
HAZWRAP Contractor: IT Corp	Dev. Contractor:		
Dev. Start (10:38 m)	Dev. End: (11:40 m)	Csg Dia: 4" ID	
Developed by: Kayne Environmental		Dev. Rig (Y/N)	
Developed 2-5-91			

Dev. Method Surge with surb, bail, submersible pump

Equipment 3 5/8" Bottom loading steel bailer, 1.5 HP Franklin submersible pump

Pre-Dev. SWL 76.40 ft Maximum drawdown during pumping NA ft at NA gpm

Range and Average Discharge rate 5-20 gpm 12 gpm nominal gpm

Total quantity of material bailed ~14 gals

Total quantity of water discharged by pumping ~205 gals

Disposition of discharge water Held in poly tank for analysis

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1038	10		Muddy	Muddy	21.8	7.15	1200	
1121	25		Cloudy	Cloudy	22.7	6.95	1240	
1125	70		st gally Cloudy	st gally Cloud	22.6	6.85	1210	
			131.0					
1130	146		78.8	Clear	22.6	6.94	1170	
1133	165		30.2	Clear	22.8	7.04	1150	
1137	200		18.9	Clear	22.8	7.08	1140	
1140	220		19.5	Clear	21.7	7.15	1230	

FIGURE 5-4C

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No. <u>MWS-04</u>	Page <u>1</u> of <u>1</u>
Installation <u>Sky Harbor</u>	Coordinates	Site <u>Sky Harbor Background Well</u>	
Project No. <u>40721.02.06</u>	Client/Project <u>HAZWAP / Sky Harbor Area</u>		
HAZWAP Contractor <u>IT Corporation</u>	Dev. Contractor <u>Lowe Environmental</u>		
Dev Start <u>(9:30 a.m.) 3/24/91</u>	Dev End <u>(2:02 p.m.) 3/26/91</u>	Csd Dia. <u>4 in. I.D.</u>	
Developed by <u>Gordon / Winkler</u>		Dev Rig <u>(Y) N</u>	

Dev Method Surge w/ 4 in. Surge for 15-20 minutes, Bail for approximately 30-40 gal, then pump until water clarity & turbidity are ≤ 20 NTU

Equipment Development Rig, pH Meter, Conductivity Meter, Temp. Probe

Pre-Dev. SWL 74.92 Maximum drawdown during pumping NA ft at NA gpm

Range and Average Discharge rate 3-55 GPM / Average Rate Approx 5 gpm

Total quantity of material bailed 55 gal

Total quantity of water discharged by pumping 165 gal

Disposition of discharge water Consolidated on site pending water quality analysis

Time	Volume Removed (gals)	Water Level ft BTQ	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
0935	20	74.92	NA	Cloudy	20.8	7.03	1170	Very small amt (0.01 ft.?) of BSH in well
1120	35		"	"	20.5	6.67	1140	
1123	50		"	"	22.5	6.74	1170	
1125	60		"	"	21.8	6.82	1170	
1129	70		"	"	22.1	6.85	1140	
1132	80		"	"	22.5	6.80	1150	
1137	90		77	"	23.2	6.82	1140	
1141			71	Slightly Cloudy	23.3	6.74	1160	
1145	150		100	"	22.4	6.81	1100	
1147	165		54.5	"	23.1	6.83	1020	
1151	190		40.7	Very Slightly Cloudy	23.2	6.81	996	
1154	200		31.8		22.8	6.83	1130	
1159	220	75.06	25.2		23.1	6.78	1050	

NOTE: NA = Not Analyzed For.

WELL DEVELOPMENT LOG		Well No.: MW1-02	Page 1 of 1
Installation:		Site: 1	
Project No.: 409721.02.06		Client/Project: Sky Harbor ANG Base	
HAZWRAP Contractor: IT Corp		Dev. Contractor: Hayne Environmental	
Dev. Start (10:50 AM)	Dev. End: (12:51 PM)	Csg Dia.: 4" ID	
Developed by: Hayne Environmental		Dev. Rig (Y/N)	
Developed 2-4-91			

Dev. Method 3 5/8" OD x 10' Steel Bailer - Bailer, followed by
swab, finished with pump

Equipment 3 5/8" OD x 10' Steel Bailer, 4" OD Swab, Franklin 1.5 HP
Submersible pump

Pre-Dev. SWL 77.32 ft Maximum drawdown during pumping _____ ft at _____ gpm

Range and Average Discharge rate 5-20 gpm 6 gpm nominal gpm

Total quantity of material bailed 15 gallons

Total quantity of water discharged by pumping ~425 gallons

Disposition of discharge water Held in poly tanks for analysis

Time	Volume Removed (gals)	Water Level (ft BTOC)	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1047			N/A	Cloudy Brown	22.4	7.36	1080 μ S	
1050	15			Slightly Cloudy	25.0	7.10	1100 μ S	Clearing quickly
1213	80		155.2	Clear	Low Battery	7.01	1090 μ S	Clearer
1222	165 220		36.6	Clear	—	7.03	1070 μ S	Fairly Clean
1235	240		63.2	Clear	—	6.84	1070 μ S	pH & Conductivity Stable
1242	295		78.9	Clear	—	—	—	
1245	330		31.3	Clear	—	—	—	
1247	360		27.7	Clear	—	—	—	
1250	585		26.0	Clear	—	—	—	
1252	410		17.5	Clear	—	—	—	
1254	440		14.2	Clear	—	—	—	

Shut pump down

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No.: MW2-02	Page 1 of 1
Installation: 50 ft of screen Top at 50 bgs.		Site: Site Z	
Project No.: 409721	Client/Project: MMEIS / Sky Harbor ANG		
HAZWRAP Contractor: JT Corp	Dev. Contractor: Layne Env.		
Dev. Start (8:15 A.M.)	Dev. End: (10:15 A.M.)	Csg Dia.: 4 inch	
Developed by: Bailing, Surging, Pumping (Tybirk)		Dev. Rig (Y/N)	

Developed 2-9-91

Dev. Method Surging saturated screen interval, bail, pump to
visibly clear or SNTU's.

Equipment Small development rig.

Pre-Dev. SWL 75.59 Maximum drawdown during pumping 99.74 ft at ~ 6 gpm gpm

Range and Average Discharge rate approx 6 gpm while pumping gpm

Total quantity of material bailed 20 gals

Total quantity of water discharged by pumping 180 gals

Disposition of discharge water To be determined

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
0815	-	75.59	-	-	-	-	-	Start surging
0845	-	-	-	-	-	-	-	Run bailer in well
0855	20 gals	-	-	Brown	20.1	6.84	1150	Begin to set pump
0935	60 gals	-	-	Light Br.	21.7	6.35	1250	Began pumping 0930
0940	70 gals	-	-	Light Br	21.8	6.28	1130	Stop pump temporarily
0945	80 gals	-	-	Cloudy	22.1	6.40	1120	
0950	110 gals	-	-	Cloudy	22.1	6.98	1130	
1000	130 gals	-	-	Sl. Cloudy	21.9	7.04	1170	
1001	135 gals	-	58.2	Sl. Cloudy	22.3	7.15	1140	
1005	160 gals	-	47.5	sl. Cloudy	22.5	7.11	1190	
1008	180 gals	-	31.5	Clear	22.3	7.21	1150	
1015	200 gals	99.74	25.8	Clear				Considered clear enough.

FIGURE 5-4c

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No.: MW3-01	Page 1 of 1
Installation: Sky Harbor	Coordinates	Site: 3	
Project No.: 401221.02.06	Client/Project: HAZWRAP/Sky Harbor ANK		
HAZWRAP Contractor: IT Corporation	Dev. Contractor: LAYNE Environmental		
Dev. Start () () m) 3/14/91	Dev. End: () () m)	Csq Dia.: 4.0 in. ID	
Developed by: GARDIN/WOLKIN		Dev. Rig: (Y) N	

Dev Method SURGE
Surge w/ 4 in Surges For 15-20 minutes, Bail For Approx
30-40 gal, Then Pump until water clarity/15 X ≤ 20 NTU
Turbidity

Equipment Development Rig, pH meter, Conductivity meter, Turb Probe

Pre-Dev. SWL 75.82 Maximum drawdown during pumping _____ ft at _____ gpm

Range and Average Discharge rate 3-5 GPM _____ gpm

Total quantity of material bailed 55 Gallons

Total quantity of water discharged by pumping 155

Disposition of discharge water CONTAMINATED AND SITE PENDING WATER QUALITY ANALYSIS

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1120	0	75.28	-	-	-	-	-	Strong odor from well
1140	15	-	-	very cloudy	20.6	6.93	970	
1145	40	-	-	"	21.0	7.02	1070	
1148	55	-	-	"	21.4	7.01	1050	
1210	80	-	-	"	20.9	6.88	1110	
1213	95	-	-	cloudy	22.0	6.83	1020	
1216	105	-	-	"	23.1	6.79	1060	
1220	120	-	-	slightly clear	23.3	6.78	1060	
1225	140	-	-	"	22.7	6.79	1050	
1230	160	-	137.6	"	22.4	6.75	1050	
1235	175	-	102.3	"	23.7	6.77	1050	
1239	190	-	92.1	"	23.6	6.76	1000	
1243	205	-	64.0	"	24.0	6.75	1010	
1245	215	-	41.1	"	23.7	6.77	1000	
		75.3			23			

WELL DEVELOPMENT LOG		Well No. <u>WU 3-02</u>	Page <u>1</u> of <u>1</u>
Installation: <u>Sky Harbor</u>	Coordinates	Site: <u>3</u>	
Project No.: <u>409721.02.06</u>	Client/Project: <u>HAZWRAP / Sky Harbor ARV</u>		
HAZWRAP Contractor: <u>ITC</u>	Dev. Contractor: <u>LAMAR ENVIRONMENTAL</u>		
Dev. Start (<u> </u> m)	Dev. End: (<u> </u> m)		Csg Dia. <u>4 in. I.D.</u>
Developed by: <u>GARDIN / LAMAR</u>			Dev. Ric. <u>(Y/N)</u>

Dev. Method Swirl w/ 4 in. Swags for 15-20 minutes, Bail for approximately 30-40 gals, then pump until water clarity & turbidity is ≤ 20 NTU

Equipment Development Rig, pH meter, Conductivity meter, Temp. probe

Pre-Dev. SWL 76.23 Maximum drawdown during pumping _____ ft at _____ gpm

Range and Average Discharge rate 3-5 gpm

Total quantity of material bailed 270 55 gals.

Total quantity of water discharged by pumping 155 gals

Disposition of discharge water CONTAINED ON SITE PENDING WATER QUALITY ANALYSIS

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
0830	15	76.23	NA	cloudy	19	6.73	1150	
0833	45		NA		19.2	6.76	1140	
0900	60		NA		19.7	6.77	1130	
0904	75				21.5	6.83	1010	
0908	80				22.0	6.75	1030	
0912	95				22.7	6.73	1080	
0915	110				22.9	6.83	980	
0920	130				23.1	6.74	1070	
0923	145				22.7	6.77	960	
0925	175		513	slightly cloudy	23.1	6.74	1010	
0930	180		50.0		23.0	6.78	980	
0935	200		45.6	clear	23.0	6.72	1010	
0940	210		24.6	clear	22.2	6.83	1110	
		* 73.64	18.1					

* Finishing crew cut off several inches of well casing when finishing well.

FIGURE 5-4c

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No. <u>MM5-01</u>	Page <u>1</u> of <u>1</u>
Installation: <u>Sky Harbor</u>	Coordinates	Site: <u>Site 5</u>	
Project No.: <u>409721</u>	Client/Project <u>MMES / Sky Harbor ANG</u>		
HAZWRAP Contractor: <u>IT Corp</u>	Dev. Contractor <u>Layne Env.</u>		
Dev Start: <u>(13:45 m)</u>	Dev End: <u>(14:55 m)</u>	Csg Dia.	
Developed by <u>Tykwaki</u>		Dev Rig <u>(Y/N)</u>	
Developed <u>2-9-91</u>			

Dev Method Surge saturated screen interval, bail coarse sediment,
pump to clear or NTU of 5.

Equipment Small Development rig

Pre-Dev. SWL 76.50 Maximum drawdown during pumping 96.70 ft at 4-6 gpm

Range and Average Discharge rate 3-8

Total quantity of material bailed 20 gals

Total quantity of water discharged by pumping 190

Disposition of discharge water To be determined. Held in poly to test

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity NTUs	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1345	-	76.50	-	-	-	-	-	Start Surging
1355	-	-	-	-	-	-	-	Stop surging, run water
1400	20 gals	-	-	-	-	-	-	Start to run pump in well.
1415	20 gals	-	-	-	-	-	-	Start pump
1420	25 gals	-	-	Brown	24.6	6.76	1110	
1425	70	-	-	Lt. Brown	24.1	7.20	1060	
1430	90	-	-	Lt. Brown	24.5	7.22	1060	
1435	110	-	-	Lt. Grey	23.9	7.20	1070	
1440	130	-	-	Cloudy	24.1	7.35	1080	
1443	150	-	-	Cloudy	23.7	7.22	1070	
1446	170	-	-	Sl. Cloudy	23.8	7.27	1080	
1448	180	-	-	Sl. Cloudy	23.6	7.25	1080	
1452	210	-	64.0	Sl. Cloudy	23.6	7.26	1080	Clear enough
1455	-	-	-	-	-	-	-	Stop

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No.: PP-01	Page 1 of 1
Installation:		Site: PARAGO ANG	
Project No.: 40924-02-06	Client/Project: MARES / AZ ANG		
HAZWRAP Contractor:	Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICE CO.		
Dev. Start (11:47 m)	Dev. End: (12:22 m)	Csg Dia.: 2"	
Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO. J.S. FL. CORP.		Dev. Rig (Y/N)	

Developed 1-29-91

Dev. Method 1.25 O.D. x 9.90 PVC BOTTOM LOADING BAULER w/ DEDICATED ROPEEquipment SMALL RG USING HOIST + HAND PULLING.Pre-Dev. SWL 30.84 Maximum drawdown during pumping N/A ft at N/A gpmRange and Average Discharge rate N/A gpmTotal quantity of material bailed 17 GALLONSTotal quantity of water discharged by pumping N/ADisposition of discharge water PORED NO SS OR DMS + LABELED BY PILOMETER NUMBER

Time	Volume Removed (gals)	Water Level ft BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1118	1			PAWISH	22.6	7.02	1740	MOVEMENTS BEFORE INSERT FIRST BAULER
1134	3			PAWISH	22.9	7.20	1610	VOLUME REMOVED FROM WELL.
1145	6			PAWISH	23.0	7.20	1560	WATER HAS A SLIGHT OOR. I CAN NOT DESCRIBE SLIGHTLY.
								SLIGHT OOR. MIXTURED
								WATER LEVEL LEVEL DROPPED 16" AFTER REMOVAL 6 GALLONS
1200	9			PAWISH	22.8	7.29	1510	SLIGHT OOR. CLAYOFF
1209	12			PAWISH	22.9	7.24	1500	SIXTY.
								SLIGHT OOR. CLAYOFF
								SIXTY.
1216	16			PAWISH	22.8	7.20	1620	SLIGHT OOR, CLAYOFF, SIXTY

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No.: PP-02	Page 1 of 1
Installation:		Site: PARRO ANG	
Project No.: 40921-02-06	Client/Project: MIES / A2 ANG		
HAZWRAP Contractor:	Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO.		
Dev. Start (12:52 m)	Dev. End: (14:25 m)	Csg Dia: 2"	
Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO. J.S. III. (P)		Dev. Rig (D/N)	

Developed 1-29-91

Dev. Method 1.25^{ad} x 9.75 PVC BOTTOM LOADING BAILER w/ DEDICATED ROPE.Equipment SMALL RIG w/ HOIST USING ROPE + HAND PULLINGPre-Dev. SWL 37.45 Maximum drawdown during pumping N/A ft at N/A gpm

Range and Average Discharge rate _____ gpm

Total quantity of material bailed 42 GALLONSTotal quantity of water discharged by pumping N/ADisposition of discharge water POURED INTO SS AND DMS + LABELED BY PERMETER DUMPER

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/ Color	Temp °C	pH	Conductivity	Remarks
1303	43			Brown	24.0	7.22	1980	MUDDY, NO ODOOR. HAD TO BAL 4 GALS OF WATER COMING OUT MUDDY.
1309	6			Brown	22.7	7.37	1990	MUDDY, NO ODOOR
1321	9			Brown	23.8	7.37	1950	MUDDY, NO ODOOR
1326	12			Brown	24.4	7.40	1920	MUDDY, NO ODOOR
1331	15			Brown	24.7	7.30	1980	SLIGHTLY MUDDY, NO ODOOR
1347	21			Brown	24.8	7.29	1990	SLIGHTLY MUDDY, NO ODOOR
1400	20			Brown	24.4	7.29	2000	
1413	41			Muddy clear	24.5	7.34	2020	ALMOST CLEAR, NO ODOOR

WELL DEVELOPMENT LOG		Well No.: PP-03	Page 1 of 1
Installation:		Site: PARGO ANG	
Project No.: 409721	Client/Project: NMES / A3 ANG		
HAZWRAP Contractor:	Dev. Contractor: SOUTHWEST ENVIRONMENTAL WELL SERVICES		
Dev. Start (09:21m)	Dev. End: 10:39m	Csg Dia.: 2"	
Developed by: SOUTHWEST ENVIRONMENTAL WELL SERVICES CO.		Dev. Rig (Y/N)	

Developed 1-29-91

Dev. Method 1.25 O.D. X 9.90 PVC BOTTOM LOADING BAILER W/ DEDICATED POLY ROPE.

Equipment SMEAL P.C. w/ HOIST. PULLING BAILER BY HAND.

Pre-Dev. SWL 32.30 Maximum drawdown during pumping N/A ft at N/A gpm

Range and Average Discharge rate _____ gpm

Total quantity of material bailed 11 GALLONS

Total quantity of water discharged by pumping N/A

Disposition of discharge water POURED INTO 55 GNL DRUM + LABELED BY PIROMETER NUMBER

Time	Volume Removed (gals)	Water Level ft BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
0935	~1			SLIGHTLY CLOUDY, NO ODOOR	23.7	7.08	1330	measured. PRESENT FIRST BAILER VOLUME.
0944	~2			BROWNISH	23.8	7.18	1360	SINK 37.83. STOPPING WELL FOR ~10 MIN. BETWEEN FOLD PIROMETER
0954	~2.5			BROWNISH	24.5	7.26	1320	WATER SLIGHTLY CLOUDY. NO ODOOR
1006	3.5			BROWNISH	23.3	7.30	1320	WATER SLIGHTLY CLOUDY. NO ODOOR
1018	4.5			BROWNISH	23.9	7.32	1310	SLIGHTLY CLOUDY, NO ODOOR
1035	10			BROWNISH	23.6	7.32	1330	SLIGHTLY CLOUDY, NO ODOOR POURED 5 GALS INTO 55 GNL DRUM + WATER LEVEL DROPPED FROM 48.96 TO 57.45

FIGURE 5-4c

REV. DATE: MAY 1990

WELL DEVELOPMENT LOG		Well No.: <u>W4-02</u>	Page <u>1</u> of <u>2</u>
Installation: <u>Sky Harbor</u>	Coordinates	Site: <u>4 (Paved)</u>	
Project No.: <u>40121.02.06</u>	Client/Project: <u>HAZWAP / Sky Harbor Park</u>		
HAZWAP Contractor: <u>ITC</u>	Dev. Contractor: <u>Layne Environ.</u>		
Dev. Start: <u>(16:45 A.M.) 2/14</u>	Dev. End: <u>(16:00 P.M.) 2/14</u>	Csg Dia: <u>4-in I.D.</u>	Dev. Rig: <u>(N)</u>
Developed by: <u>Ward</u>			

Dev. Method Surge w/ 4 wheel Surger for 30 minutes; Bore w/ 10 ft (Sph. Probe) to STANDARD Turbidity, pH, Temp, Conductivity

Equipment Development Rig, pH/Conductivity Meter, Turbidity meter.

Pre-Dev. SWL 27.41 ft Maximum drawdown during pumping Boiled Dr ft at _____ g

Range and Average Discharge rate _____ g

Total quantity of material bailed N 50AL to 1 bag of sand/silt; w/ 45 gal water

Total quantity of water discharged by pumping 0

Disposition of discharge water Drummed and SITE ALTERN DEBRIS AREA AT PARKED

Time	Volume Removed (gals)	Water Level ft. BTOC	Turbidity	Clarity/Color	Temp °C	pH	Conductivity	Remarks
1045	0	27.41						Initial.
1125	10		194	Brown	26.2	7.02	930	
1128	20		192	↓	26.2	7.33	940	
1130	27 1/2		—	↓	26.1	7.25	970	Turbidity meter
1132	31 1/2		—	LT. Brown	25.8	7.15	940	Now functioning
1227	35		—	↓	26.7	7.36	980	
1305	37		—	↓	26.5	7.31	990	
1340	39		—	very LT. Brown	26.6	7.40	890	11
1435	42		—	"	26.4	7.38	910	11
1505	43 1/2		—		26.5	7.43	960	11
1600	45		—	slower	26.3	7.43	950	11
1602	45 1/2		—	lower	26.2	7.45	960	11

Based on color & amount of OPAQUENESS, TURBIDITY WAS PROBABLY REDUCED BY ABOUT 1/2 of STARTING VALUE.